CONFERENCE ON DISARMAMENT

CD/1178
15 January 1993

ENGLISH ONLY

LETTER DATED 13 JANUARY 1993 FROM THE PERMANENT REPRESENTATIVE OF ROMANIA ADDRESSED TO THE SECRETARY-GENERAL OF THE CONFERENCE ON DISARMAMENT TRANSMITTING THE TEXT OF THE DECISION OF THE GOVERNMENT OF ROMANIA ON THE IMPORT AND EXPORT REGIME OF ITEMS AND TECHNOLOGIES UNDER FINAL DESTINATION CONTROL, AS WELL AS ON THE EXPORT CONTROL REGIME FOR THE NON-PROLIFERATION OF NUCLEAR, CHEMICAL AND BIOLOGICAL WEAPONS AND OF MISSILES CARRYING SUCH WEAPONS

I have the honour to forward to you the attached Decision No. 594 on the import and export regime of items and technologies under final destination control, as well as on the export control regime for the non-proliferation of nuclear, chemical and biological weapons and of missiles carrying such weapons, taken by the Government of Romania on 28 September 1992.

I would be most grateful if, in accordance with the established practice, you would arrange for this decision to be issued as an official document of the Conference on Disarmament and circulated to all delegations, both member and observer States.

(Signed) Romulus NEAGU
Ambassador
Permanent Representative of
Romania

THE GOVERNMENT OF ROMANIA

DECISION

ON THE IMPORT AND EXPORT REGIME OF ITEMS AND TECHNOLOGIES UNDER FINAL DESTINATION CONTROL, AS WELL AS ON THE EXPORT CONTROL REGIME FOR THE NON-PROLIFERATION OF NUCLEAR, CHEMICAL AND BIOLOGICAL WEAPONS AND OF MISSILES CARRYING SUCH WEAPONS

The Government of Romania decides:

Section I
The import and export regime of items and technologies under final destination control

Art. 1

1. The items and technologies under final destination control are those contained in Annex 1.
2. "Technology", under the provisions of this Decision, means specific information, other than that in the public domain, necessary for the development, production or use of an item."Information" also covers technical data or technical assistance.

Art. 2

The import and export, irrespective of the customs regime, of the items and technologies under final destination control contained in Annex 1, shall be authorized only subject to an import licence type A and an export licence type B, respectively. These licences are those in Annexes 2A and 2B, respectively.

Art. 3

1. Subject to this Decision, as well, are all commercial activities with foreign persons referring to purchases and/or sales of items and technologies contained in Annex 1, carried out without the physical pass of Romanian customs territory, as well as linked shipments, transit or trans-shipments, in case the final destination is changed.
2. These activities can only be carried out subject to type A import licenses and type B export licenses, respectively.

Art. 4

The provisions of this Decision are applicable to all items and technologies contained in Annex 1, irrespective of the country of origin or country of production, including items and technologies manufactured in Romania.

Art. 5

1. The items and technologies under final destination control shall be accompanied by a copy of the export licence, issued by the exporting country.
2. The items and technologies shall be delivered to the importer only, in the quatities and according to the technical data contained in the corresponding documents, including the export licence. Any change of destination or use shall be previously authorized by the authority which issued the original documents.

Art. 6

1. Exporters and importers of items and technologies under final destination control are under the obligation to state whether these items and technologies are subject to the provisions of Annex 1 and to request the type A import licence and the type B export licence, respectively.

2. Also, persons provided for under art. 10 are under the obligation to specifically state in the customs declaration whether the respective merchandise is subject to the provisions of this Decision.
3. In case the import customs check is performed at a customs point within the Romanian customs territory, the importer is under the obligation to present at the destination customs point the items and technologies under control, within the time frame established by the customs authority at the border.
4. In case the export customs check is performed at a customs point within the Romanian customs territory, the exporter is under the obligation to present the documents, together with the items and technologies, at the border customs point, within the time frame established by the customs authority within the territory.

Art. 7

1. Any importer of an item or technology provided for in Annex 1 has the obligation to provide to the exporter an IMPORT CERTIFICATE and a DELIVERY CONTROL CERTIFICATE.
2. By issuance of the Import Certificate or the equivalent document, the issuing authority undertakes:
   a) - to attest that the importer's statements are accurate and to send notice to the competent authorities, according to its legislation, to the purpose of sanctioning any false statement on the end use of items and technologies under control;
   b) - to supervise the use of items and technologies under control according to the stated use;
   c) - to allow the authority from the exporter's country to perform the necessary controls

regarding the conclusion and carrying out of the transaction;

d) - to transmit to the authority from the exporter's country, upon request, a Delivery Control Certificate;

e) - to observe any other requests specific to the transfers of items and technologies under control, in accordance with international conventions.

3. The Delivery Control Certificate confirms that the items and technologies reached their destination, in the quatities and according to the technical data contained in documents and were used for the stated purpose.
4. The forms for the Import Certificate (IC) and Delivery Control Certificate (DCC) are those contained in Annexes 3A and 3B, respectively.

Art. 8

1. A copy of the Import Certificate presented by the applicant shall be transmitted, through diplomatic channels, by the issuing authority to the competent authority in the exporter's country.
2. Issuance of type A and B licences shall be permitted only if there is identity of the Import Certificate and this copy.

Art. 9

The data and information concerning any of the elements referring to the activities provided for under art. 2 and 3, supplied by the importers and/or exporters of items and technologies contained in Annex 1, shall be certified by those authorized to pledge their legal responsibility, who shall be liable for the accuracy and veracity of the respective documents.

Art. 10

1. The provisions of this Decision are applicable to all persons involved in activities provided for under art. 2 and 3.
2. "Person" means any natural or legal person, including governmental institutions, irrespective of their being Romanian or foreign.

Art. 11

1. Type A and B licenses shall be individually issued by the Ministry of Trade and Tourism.
2. The licence application shall compulsorily include, besides the tariff item position, the relevant article and paragraph numbers in the annexes to this Decision.
3. The validity for type A and B licences is 6 months. In case an extension of validity is needed, the documents referred to in this Decision shall be countersigned/reconfirmed.
4. The above licences may be used only by those persons enlisted as suppliers/ senders/ sellers/ exporters and end-users/ addressees/buyers/exporters.
5. These licences may not be assigned, not even in case of merging, dividing or other forms of re-organization of legal persons.
6. Persons provided for under art. 10 are under the obligation to declare immediately to the Ministry of Trade and Tourism any changes and/or differences noticed in the documents and/or during the delivery/reception of the respective items and technologies. Should such changes alter the conditions upon which the respective licence was issued, any declaration of such changes may be considered as a new licence application and consequently the licence may be cancelled.

Art. 12

For countries having legal provisions similar to this Decision, the following documents shall be used:

a) - the document allowing final destination control is the IMPORT CERTIFICATE (IC); in order to obtain an IC document, the importer shall fill in an application, in accordance with Annex 3B;

b) - the document allowing post-shipment check of final destination is the DELIVERY CONTROL CERTIFICATE (DCC); in order to obtain a DCC, the importer shall fill in an application, in accordance with Annex 4B;

c) - if partner countries issue equivalent documents, those documents can be used.

Art. 13

1. In the relationship with business partners from countries having legal provisions similar to this Decision, the following rules shall apply:

   a) - for export:

   - the exporter shall request from his business partner the IC document or its equivalent, issued by the competent authorities from the importing country; this document shall compulsorily be attached to the type B licence application, together with the approval of the competent authority;
   - after delivery, but not later than three months from that date, the exporter shall obtain from his business partner the DCC or any other equivalent document, to the effect that the merchandise has reached destination; the exporter shall present this document to those authorities who have issued the type B licence within 120 days from the date the export was carried out.

b) - for import:

- the importer shall provide to his business partner the IC and DCC documents, as well as the import customs declaration copy, at request;
- fulfillment of these obligations does not exonerate the importer from complying with the other legal provisions contained in this Decision.

2. If the business partner of the importer requests supplementary evidence that the import was carried out, besides the copy of the customs import declaration, the General Customs Division shall issue such confirmation, stating that the merchandise has passed the Romanian border and entered its customs territory.

Art. 14

1. For countries having no legal provisions similar to this Decision, the following documents shall be used and the following rules shall apply:

a) - for export, issuance of type B licence shall be conditioned by the submission of a certificate from the end-user/ addressee/ importer/ buyer, making a committment to use the merchandise only in his country, to the stated end-use, and to transmit evidence to this effect to the supplier/ sender/ exporter/ seller; this certificate shall be in writing, signed by those authorized to pledge the legal liability of the end-user/ addressee/ importer/ buyer, as well as by those authorized to pledge the accuracy and veracity of the respective documents; this commitment shall result clearly from the text of the certificate;

b) - for import, issuance of type A licence is not conditioned by any supplementary document, other than the Import Certificate.

2. These rules shall apply to all activities provided for under art. 2 and 3.

Art. 15

1. Final destination control of items and technologies in Annex 1 sets up the obligation, for persons carrying out activities provided for in art. 2 and 3, to ensure the arrival of these items and technologies at their destination, as well as that of producing the documents provided for in this Decision.
2. The obligation of providing the documents specified in para 1 applies also to the end-users.

Art. 16

The persons' names, addresses, telephone, facsimile and telex contacts shall be written on all documents provided for in this Decision.

Art. 17

For issuance of import and export licences for military products, a prior recommendation is necessary, in accordance with the provisions of the Government Decision no. 547 of September 11, 1992, on the import and export of special products.

SECTION II

The export control regime for the non-proliferation of nuclear, chemical and biological weapons and of missiles carrying such weapons

Art. 18

1. The technologies, materials, substances, equipments, installations and components therefor under control are those contained in Annexes 5 to 8.

2. The import and export of items and technologies provided for under para 1 shall be made according to the provisions of Section I, which shall be duly applied, as well as according to the specific requirements contained in Annexes 5 to 8.

Art. 19

1. For issuance of import and export licences for nuclear products, a prior recommendation is necessary, in accordance with the provisions of Law no. 61/1974.

SECTION III

The National Export Control Agency

Art. 20

1. In order to implement the provisions of this Decision, the National Export Control Agency, subsequently called "the Agency", is set up. The Agency is a specialized body, under the authority of the Government, having legal personality and its own budget. The Agency is headed by a Director General and has the structure provided for in Annex 9.
2. The Agency is coordinated by an Interministerial Council, at state secretary or under-secretary level, in which the Ministry of Foreign Affairs, the Ministry of Trade and Tourism, The Ministry of National Defence, the Ministry of Economy and Finance, the Ministry of Industry, the Ministry of Communications, the Ministry of the Environment, the Ministry of the Interior and the Ministry of Justice are represented.
3. The Interministerial Council examines and approves the import and export applications for the items and technologies provided for under this Decision, in accordance with Romania's international commitments, with national economic and security interests, taking also into account the activities of the end-users, the reliability of the applicants and other relevant

considerations for the efficient functioning of the regime set up by this Decision.

Art. 21

In order to fulfill its duties, the Agency shall set up a Control Corps, made up of the Agency's specialists and other experts, which shall be used as needed. The Agency shall bear the costs necessary for the control activities.

Art. 22

The Agency has the following competence:

a) - checks the conformity and accuracy of statements made by persons engaged in activities provided for under art. 2 and 3;

b) - checks, in books and on site, when necessary, the aspects relevant for the conclusion, carrying out or completion of export or import transactions, having as object the items and technologies under control;

c) - cooperates with similar authorities in partner countries, according to the provisions of this Decision;

d) - analyzes and advises upon the Import Certificate or equivalent documents, issued by the competent authorities from the importing countries, to the purpose of issuing type B export licences;

e) - issues the Import Certificate and the Delivery Control Certificate for imports having as destination the territory of Romania;

f) - informs the National Evidence and Control System for Nuclear Materials as to the issued documents;

g) - informs the Government periodically, in cooperation with the Ministry of Trade and Tourism and the General Customs Division, as to the commercial activities provided for under this Decision;

h) - advises on the interdiction of concluding or on stopping the carrying out of activities provided for under art. 2 and 3 in case of infringement of the provisions of this Decision;

i) - initiates, with the competent institutions, the updating of annexes to this Decision, in accordance with the international commitments of Romania.

Art. 23

International cooperation in this field has as main objectives:

a) - reciprocal information and consultations in case of licence applications for items and technologies under control, if there are substantial indications concerning the possibility of their use for purposes other than those stated;

b) - updating and uniform implementation of the regulations in this field, including the lists of items and technologies under control;

c) - sends notice on the infringements of the control regime, in order for these to be sanctioned by the competent authorities.

Art. 24

1. The Agency organizes, with the assistance of the competent ministries, an extensive information programme for the other institutions cooperating in the implementation of this Decision, as well as for

economic agents, concerning the objectives, principles, norms and procedures of the import and export control regime of items and technologies under final destination control and the export control regime for the non-proliferation of nuclear, chemical and biological weapons and of missiles carrying such weapons.

2. The Agency and, when necessary, the competent ministries shall provide, upon request, specialized consultancy to economic agents interested in performing the activities provided for under art. 2 and 3, having as object items and technologies under control.

SECTION IV
Sanctions and other provisions

Art. 25

1. Infringement of the provisions of this Decision on import and export activities, as well as of those on the accuracy and veracity of statements, which are considered criminal acts according to law, shall be punished in accordance with the provisions of the Penal Code.
2. Infringements of the provisions of art. 6, paras 3 and 4, art. 11, paras 2, 4, 5 and 6, art. 13, para 1, letter a, art. 15 and 16, inasmuch as they are not considered criminal acts according to law, are offenses and shall be punished by a fine of up to two to five times the amount of the transaction.
3. Offenses shall be determined and fines shall be decided by the Agency and Customs personnel, especially authorized by the heads of those institutions.
4. For the offenses provided for in this article are applicable the provisions of the law on establishing and sanctioning of offenses.

Art. 26

1. The General Customs Division checks the reality and accuracy of the data and information provided in the documents necessary for the carrying out of activities provided for under art. 2 and 3. Also, the General Customs Division and, as the case may be, together with the other competent ministries:
   - a) - prevents, identifies, investigates and prosecutes all activities illegal under this Decision;
   - b) - stops and inspects vehicles and merchandise in-transit: searches premises, buildings, goods, stores and takes samples for identification; inspects books and correspondence and makes copies thereof; requests any authority or person to produce documentation and data regarding trade in controlled items and technologies;
   - c) - supervises the observance of conditions of loading, transportation, unloading, installation and storage of items and technologies under control;
   - d) - obtains the cooperation and assistance of persons engaged in sale, distribution or transport of items and technologies under control, for the purpose of implementing this Decision.
2. Whenever necessary, in compliance with international treaties, agreements or other commitments to which Romania is party, the procedure for issuance of licences and enforcement of the provisions of this Decision may include, together with Romanian officials, competent officials of the exporting country. Such cooperation shall include pre-licence and post-shipment verification procedures, as well as general cooperation in enforcing relevant export control regulations.

3. For export, persons acting as sellers are compelled to mention their right of control, directly or through the Agency, on the final destination of the merchandise, in the concluded contracts.

Art. 27

1. For export or import activities provided for under art. 2 and 3, being carried out at the date of coming into force of this Decision, having as object items and technologies under control, a licence or, as the case may be, a reconfirmation of licence, according to the provisions of this Decision, shall be requested within 30 days of the date of its coming into force.
2. If the request is not made within 30 days, the previously issued licence shall be automatically cancelled, and operations being carried out shall be suspended until another licence is obtained.
3. If, within 45 days of the coming into force of this Decision the licence or, as the case may be, reconfirmation of licence is not obtained, operations being carried out shall be stopped until a licence is obtained.

Art. 28

1. Annexes 1 to 9 are an integral part of this Decision.
2. This Decision comes into force 15 days after its publication in the Official Gazette of Romania.
3. Any contrary disposition is repealed.

PRIME MINISTER
THEODOR STOLOJAN

Bucharest, 28 September 1992
No 594

Contents of Annexes

Page

Annex No.1 - Items and technologies under final destination control 18

Annex No.2A - Import licence type A 267

Annex No.2B - Export licence type B 268

Annex No.3A - Import Certificate (form) 269

Annex No.3B - Request for an Import Certificate (form). . . 270

Annex No.4A - Delivery Control Certificate (form) 271

Annex No.4B - Request for a delivery Control Certificate (form). 273

Annex No.5 - Technologies and items subject to non-proliferation of nuclear weapons control 275

Annex No.6 - Technologies and items subject to non-proliferation of chemical weapons control 348

Annex No.7 - Technologies and items subject to non-proliferation of biological weapons control 353

Annex No.8 - Technologies and items subject to non-proliferation of delivery missiles for mass-destruction weapons control. 358

Annex No.9 - The National Export Control Agency (Structure) 379

ITEMS AND TECHNOLOGIES UNDER FINAL DESTINATION CONTROL

GROUP I - COCOM INTERNATIONAL INDUSTRIAL LIST

1000. GENERAL TECHNOLOGY NOTE

The export of "technology" which is "required" for the "development", "production" or "use" of products embargoed in the International Industrial List is controlled according to the provisions in each Category.

"Technology" "required" for the "development", "production" or "use" of a product under embargo remains under embargo even when applicable to any unembargoed product.

Controls do not apply to that "technology" which is the minimum necessary for the installation, operation, maintenance (checking) and repair of those products which are unembargoed or whose export has been authorized.

N.B.: This does not release the repair "technology" embargoed by item 1085.2.a. Controls do not apply to "technology" "in the public domain" or to "basic scientific research".

GENERAL "SOFTWARE" NOTE

This List does not embargo "software" which is either:

1. Generally available to the public by being:
   a. Sold from stock at retail selling points, without restriction, by means of:
      1. Over-the-counter transactions;
      2. Mail order transaction;
      3. Telephone call transactions; and
   b. Designed for installation by the user without further substantial support by the supplier; or
2. "In the public domain".

1010. ADVANCED MATERIALS

1011. Equipment, Assemblies and Components

1011. 1. Components made from fluorinated compounds, as follows:

- a. Seals, gaskets or fuel bladders specially designed for aircraft or aerospace use made from more than 50% of any of the materials embargoed by 1013.b. or c.;
- b. Piezoelectric polymers and copolymers made from vinylidene fluoride:
    - 1. In sheet or film form; and
    - 2. With a thickness exceeding 200 micrometre;
- c. Seals, gaskets, valve seats or diaphragms made from fluoroelastomers containing at least one vinylether monomer, specially designed for aircraft, aerospace or missile use;

1011. 2. "Composite" structures or laminates:

- a. Having an organic "matrix" and made from materials embargoed by 1013.10.c., d. or e.; or having a metal or carbon "matrix" and made from:
    - 1. Carbon "fibrous or filamentary materials" with:
        - a. A "specific modulus" exceeding 10.15 x 10^6 m; and
        - b. A "specific tensile strength" exceeding 17.7 x 10^4 m; or
    - 2. Materials embargoed by 1013.10.c.;

Technical Notes:

1. Specific modulus: Young's modulus in pascals, equivalent to N/m² divided by specific weight in N/m³, measured at a temperature of (296 ±2) K ((23 ±2)° C) and a relative humidity of (50 ±5)%.

2. Specific tensile strength: ultimate tensile strength in pascals, equivalent to N/m² divided by specific weight in N/m³, measured at a temperature of (296 ±2) K ((23 ±2)° C) and a relative humidity of (50 ±5)%;

1011. 3. Manufactures of non-fluorinated polymeric substances embargoed by 1013.8.a., in film, sheet, tape or ribbon form:

- a. With a thickness exceeding 0.254 mm; or
- b. Coated or laminated with carbon, graphite, metals or magnetic substances.

1012. Test, Inspection and Production Equipment

1012. 1. Equipment for the production of fibres, prepregs, preforms or "composites" embargoed by 1011.2 or 1013.10,as follows, and specially designed components and accessories therefor:

- a. Filament winding machines of which the motions for positioning, wrapping and winding fibres are coordinated and programmed in three or more axes, specially designed for the manufacture of "composite" structures or laminates from "fibrous or filamentary materials";
- b. Tape-laying or tow-placement machines of which the motions for positioning and laying tape, tows or sheets are coordinated and programmed in two or more axes, specially designed for the manufacture of "composite" airframe or missile structures;
- c. Multidirectional, multidimensional weaving machines or interlacing machines, including adapters and modification kits, for weaving, interlacing or braiding fibres to manufacture "composite" structures, except textile machinery not modified for the above end-uses;
- d. Equipment specially designed or adapted for the production of reinforcement fibres, as follows:
    - 1. Equipment for converting polymeric fibres (such as: polyacrylonitrile, rayon, pitch or polycarbosilane) into carbon fibres or silicon carbide fibres, including special equipment to strain the fibre during heating;
    - 2. Equipment for the chemical vapour deposition of elements or compounds on heated filamentary substrates to manufacture silicon carbide fibres;
    - 3. Equipment for the wet-spinning of refractory ceramics (such as aluminium oxide);

4. Equipment for converting aluminium containing precursor fibres into alumina fibres by heat treatment;

e. Equipment for producing prepregs embargoed by 1013.10.e. by the hot melt method;

f. Non-destructive inspection equipment capable of inspecting defects three dimensionally, using ultrasonic or X-ray tomography and specially designed for "composite" materials;

1012. 2. Systems and components therefor specially designed for producing metal alloys, metal alloy powder or alloyed materials embargoed by 1013.2.a.2., 1013.2.b. or 1013.2.c.;

1012. 3. Tools, dies, moulds or fixtures, for "superplastic forming" or "diffusion bonding" titanium or aluminium or their alloys, specially designed for the manufacture of:

a. Airframe or aerospace structures;

b. Aircraft or aerospace engines; or

c. Specially designed components for those structures or engines.

1013. Materials

1013.1. Materials specially designed for use as absorbers of electromagnetic waves, or intrinsically conductive polymers, as follows:

a. Materials for absorbing frequencies exceeding 2×10^{8} Hz but less than 3×10^{12} Hz, except materials as follows:

NOTE:
Nothing in 1013.1.a. contains magnetic materials to provide absorption when contained in paint.

1. Hair type absorbers, constructed of natural or synthetic fibres, with non-magnetic loading to provide absorption;

2. Absorbers having no magnetic loss and whose incident surface is non-planar in shape, including pyramids, cones, wedges and convoluted surfaces;

3. Planar absorbers:

a. Made from:

Technical Note:
Absorption test samples for 1013.1.a.3.a. should be a square at least 5 wavelengths of the centre frequency on a side and positioned in the far field of the radiating element.

1. Plastic foam materials (flexible or non-flexible) with carbon-loading, or organic materials, including binders, providing more than 5% echo compared with metal over a bandwidth exceeding ±15% of the centre frequency of the incident energy, and not capable of withstanding temperatures exceeding 450 K (177° C); or

2. Ceramic materials providing more than 20% echo compared with metal over a bandwidth exceeding ±15% of the centre frequency of the incident energy, and not capable of withstanding temperatures exceeding 800 K (527° C);

b. Tensile strength less than 7×10^6 N/m^2; and

c. Compressive strength less than 14×10^6 N/m^2;

4. Planar absorbers made of sintered ferrite, with:

a. A specific gravity exceeding 4.4; and

b. A maximum operating temperature of 548 K (275° C);

1013.1.b. Materials for absorbing frequencies exceeding 1.5×10^{14} Hz but less than 3.7×10^{14} Hz and not transparent to visible light;

c. Intrinsically conductive polymeric materials with a bulk electrical conductivity exceeding 10,000 S/m (Siemens per metre) or a sheet (surface) resistivity of less than 100 ohms/m^2, based on any of the following polymers:

1. Polyaniline;
2. Polypyrrole;
3. Polythiophene;
4. Poly phenylene-vinylene; or
5. Poly thienylene-vinylene;

Technical Note:
Bulk electrical conductivity and sheet (surface) resistivity should be determined using ASTM D-257 or national equivalents.

1013. 2. Metal alloys, metal alloy powder or alloyed materials, as follows:

NOTE:
1013. 2. does not embargo metal alloys, metal alloy powder or alloyed materials for coating substrates.

1013. 2. a. Metal alloys, as follows:

1. Nickel or titanium-based alloys in the form of aluminides, as follows, in crude or semi-fabricated forms:

   a. Nickel aluminides containing 10 weight percent or more aluminium;

   b. Titanium aluminides containing 12 weight percent or more aluminium;

2. Metal alloys, as follows, made from metal alloy powder or particulate material embargoed by 1013.2.b.:

   a. Nickel alloys with:

      1. A stress-rupture life of 10,000 hours or longer at 923 K (650° C) at a stress of 550 MPa; or

      2. A low cycle fatigue life of 10,000 cycles or more at 823 K (550° C) at a maximum stress of 700 MPa;

   b. Niobium alloys with:

      1. A stress-rupture life of 10,000 hours or longer at 1,073 K (800° C) at a stress of 400 MPa; or

      2. A low cycle fatigue life of 10,000 cycles or more at 973 K (700° C) at a maximum stress of 700 MPa;

   c. Titanium alloys with:

      1. A stress-rupture life of 10,000 hours or longer at 823 K (450° C) at a stress of 200 MPa; or a low cycle fatigue life of 10,000 cycles or

more at 823 K (450° C) at a maximum stress of 400 MPa;

d. Aluminium alloys with a tensile strength of:

1. 240 MPa or more at 473 K (200° C); or

2. 415 MPa or more at 298 K (25° C);

e. Magnesium alloys with a tensile strength of 345 MPa or more and a corrosion rate of less than 1 mm/year in 3% sodium chloride aqueous solution measured in accordance with ASTM standard G-31 or national equivalents;

Technical Notes:

1. The metal alloys in 1013.2.a. are those containing a higher percentage of the stated metal than of any other element.

2. Stress-rupture life should be measured in accordance with ASTM standard E-139 or national equivalents.

3. Low cycle fatigue life should be measured in accordance with ASTM Standard E-606 'Recommended Practice for Constant-Amplitude Low-Cycle Fatigue Testing' or national equivalents. Testing should be axial with an average stress ratio equal to 1 and a stress-concentration factor (K_t) equal to 1. The average stress is defined as maximum stress minus minimum stress divided by maximum stress.

1013. 2. b. Metal alloy powder or particulate material for materials embargoed by 1013.2.a., as follows:

1. Made from any of the following composition systems:

Technical Note:
X in the following equals one or more alloying elements.

a. Nickel alloys (Ni-Al-X, Ni-X-Al) qualified for turbine engine parts or components, i.e. with less than 3 non-metallic particles (introduced during the manufacturing process) larger than 100 micrometre in 10^9 alloy particles;

b. Niobium alloys (Nb-Al-X or Nb-X-Al, Nb-Si-X or Nb-X-Si, Nb-Ti-X or Nb-X-Ti);

c. Titanium alloys (Ti-Al-X or Ti-X-Al);

d. Aluminium alloys (Al-Mg-X or Al-X-Mg, Al-Zn-X or Al-X-Zn, Al-Fe-X or Al-X-Fe); or

e. Magnesium alloys (Mg-Al-X or Mg-X-Al); and

2. Made in a controlled environment by any of the following processes:
   a. "Vacuum atomisation";
   b. "Gas atomisation";
   c. "Rotary atomisation";
   d. "Splat quenching";
   e. "Melt spinning" and "comminution";
   f. "Melt extraction" and "comminution"; or
   g. "Mechanical alloying";

1013. 2. c. Alloyed materials, in the form of uncomminuted flakes, ribbons or thin rods produced in a controlled environment by "splat quenching," "melt spinning" or "melt extraction", used in the manufacture of metal alloy powder or particulate material embargoed by 1013.2.b.;

1013.3. Magnetic materials, of all types and of whatever form, having any of the following characteristics:

a. Initial relative permeability of 120,000 or more and a thickness of 0.05 mm or less ;

Technical Note:
Measurement of initial permeability must be performed on fully annealed materials.

b. Magnetostrictive alloys with:

1. A saturation magnetostriction of more than 5 x 10^{-4}; or

2. A magnetomechanical coupling factor (k) of more than 0.8; or

c. Amorphous alloy strips with:

1. A composition having a minimum of 75 percent of iron, cobalt or nickel; and

2. A saturation magnetic induction (B_s) of 1.6 T or more, and:

    a. A strip thickness of 0.02 mm or less; or

    b. An electrical resistivity of 2 x 10^{-4} ohm/cm or more;

1013.4. Uranium titanium alloys or tungsten alloys with a "matrix" based on iron, nickel or copper, with:

a. A density exceeding 17.5 g/cm^3;
b. An elastic limit exceeding 1,250 MPa;
c. An ultimate tensile strength exceeding 1,270 MPa; and
d. An elongation exceeding 8%;

1013.5. "Superconductive" "composite" conductors in lengths exceeding 100 m or with a mass exceeding 100 g, as follows:

a. Multifilamentary "superconductive" "composite" conductors containing one or more niobium-titanium filaments:

    1. Embedded in a "matrix" other than a copper or copper-based mixed "matrix"; or

    2. With a cross-section area less than 0.28 x 10^{-4} mm^2 (6 micrometre for circular filaments);

b. "Superconductive" "composite" conductors consisting of one or more "superconductive" filaments other than niobium- titanium:

    1. With a "critical temperature" at zero magnetic induction exceeding 9.85 K (-263.31° C) but less than 24 K (-249.16° C);

    2. With a cross-section area less than 0.28 x 10^{-4} mm^2; and

    3. Which remain in the "superconductive" state at a temperature of 4.2 K (-268.96° C) when exposed to a magnetic field corresponding to a magnetic induction of 12 T;

1013. 6. Fluids and lubricating materials, as follows:

a. Hydraulic fluids containing, as their principal ingredients, any of the following compounds or materials:

1. Synthetic hydrocarbon oils or silahydrocarbon oils with:

   NOTE:
   For the purpose of 1013. 6.a.1.,silahydrocarbon oils contain exclusively silicon, hydrogen and carbon.

   a. A flash point exceeding 477 K (204° C);

   b. A pour point at 239 K (-34° C) or less;

   c. A viscosity index of 75 or more; and

   d. A thermal stability at 616 K (343° C); or

2. Chlorofluorocarbons with:

   NOTE:
   For the purpose of 1013.6.a.1., chlorofluorocarbons contain exclusively carbon, fluorine and chlorine.

   a. No flash point;

   b. An autogenous ignition temperature exceeding 977 K (704° C);

   c. A pour point at 219 K (-54° C) or less;

   d. A viscosity index of 80 or more; and

   e. A boiling point at 473 K (200° C) or higher;

b. Lubricating materials containing, as their principal ingredients, any of the following compounds or materials:
   1. Phenylene or alkylphenylene ethers or thioethers, or their mixtures, containing more than two ether or thio-ether functions or mixtures thereof; or

   2. Fluorinated silicone fluids with a kinematic viscosity of less than 5,000 mm²/s (5,000 centistokes) measured at 298 K (25° C);

c. Damping or flotation fluids with a purity exceeding 99.8%, containing less than 25 particles of 200 micrometre or larger per 100 ml and made from at least 85% of any of the following compounds or materials:

1. Dibromotetrafluoroethane;

2. Polychlorotrifluoroethylene (oily and waxy modifications only); or

3. Polybromotrifluoroethylene;

Technical Note:
For the purpose of 1013. 6.:

a. Flash point is determined using the Cleveland Open Cup Method described in ASTM D-92 or national equivalents.

b. Pour point is determined using the method described in ASTM D-97 or national equivalents.

c. Viscosity index is determined using the method described in ASTM D-2270 or national equivalents.

d. Thermal stability is determined by the following test procedure or national equivalents:
Twenty ml of the fluid under test is placed in a 46 ml type 317 stainless steel chamber containing one each of 12.5 mm (nominal) diameter balls of M-10 tool steel, 52100 steel and naval bronze (60% Cu, 39% Zn, 0.75% Sn).
The chamber is purged with nitrogen, sealed at atmospheric pressure and the temperature raised to and maintained at 644 ±6 K (371 ±6° C) for six hours.
The specimen will be considered thermally stable if, on completion of the above procedure, all of the following conditions are met:

   1. The loss in weight of each ball is less than 10 mg/mm^2 of ball surface;
   2. The change in original viscosity as determined at 311 K (38° C) is less than 25%; and
   3. The total acid or base number is less than 0.40.

e. Autogenous ignition temperature is determined using the method described in ASTM E-659 or national equivalents.

1013.7. Ceramic base materials, non-"composite" ceramic materials, ceramic-"matrix" "composite" materials and precursor materials, as follows:

a. Base materials of single or complex borides of titanium having total metallic impurities, excluding intentional additions, of less than 5,000 ppm, an average particle size equal to or less than 5 micrometre and no more than 10% of the particles larger than 10 micrometre;

b. Non-"composite" ceramic materials in crude or semi-fabricated form, except abrasives, composed of borides of titanium with a density of 98% or more of the theoretical density;

c. Ceramic-ceramic "composite" materials with a glass or oxide-"matrix" and reinforced with fibres from any of the following systems:

1. Si-N;
2. Si-C;
3. Si-Al-O-N; or
4. Si-O-N;

d. Ceramic-ceramic "composite" materials, with or without a continuous metallic phase, containing finely dispersed particles or phases of any fibrous or whisker-like material, where carbides or nitrides of silicon, zirconium or boron form the "matrix";

e. Precursor materials (i.e., special purpose polymeric or metallo-organic materials) for producing any phase or phases of the materials embargoed by 1013.7.c., as follows:

1. Polydiorganosilanes (for producing silicon carbide);

2. Polysilazanes (for producing silicon nitride);

3. Polycarbosilazanes (for producing ceramics with silicon, carbon and nitrogen components);

1013. 8. Non-fluorinated polymeric substances, as follows:

a.
1. Bismaleimides;
2. Aromatic polyamide-imides;
3. Aromatic polyimides;
4. Aromatic polyetherimides having a glass transition temperature (T_g) exceeding 503 K (230° C) as measured by the wet method;

   NOTE:

   1013.8.a. does not embargo non-fusible compression moulding powders or moulded forms.

b. Thermoplastic liquid crystal copolymers having a heat distortion temperature exceeding 523 K (250°C) measured according to ASTM D-648, method A, or national equivalents, with a load of 1.82 N/mm² and composed of:

1. Either of the following:
    a. Phenylene, biphenylene or naphthalene; or
    b. Methyl, tertiary-butyl or phenyl substituted phenylene, biphenylene or naphthalene; and

2. Any of the following acids:
    a. Terephthalic acid;
    b. 6-hydroxy-2 naphthoic acid; or
    c. 4-hydroxybenzoic acid;

c. Polyarylene ether ketones, as follows:
    1. Polyether ether ketone (PEEK);
    2. Polyether ketone ketone (PEKK);
    3. Polyether ketone (PEK);
    4. Polyether ketone ether ketone ketone (PEKEKK);

d. Polyarylene ketones;

e. Polyarylene sulphides, where the arylene group is biphenylene, triphenylene or combinations thereof;

f. Polybiphenylenethersulphone;

1013. 9. Unprocessed fluorinated compounds, as follows:

a. Copolymers of vinylidene fluoride having 75% or more beta crystalline structure without stretching;

b. Fluorinated polyimides containing 30% or more of combined fluorine;

c. Fluorinated phosphazene elastomers containing 30% or more of combined fluorine;

1013. 10. "Fibrous and filamentary materials" which may be used in organic "matrix", metallic "matrix" or carbon "matrix" "composite" structures or laminates, as follows:

a. Organic "fibrous or filamentary materials" (except polyethylene) with:

    1. A "specific modulus" exceeding 12.7 x 10^6 m; and
    2. A "specific tensile strength" exceeding 23.5 x 10^4 m;

b. Carbon "fibrous or filamentary materials" with:

    1. A "specific modulus" exceeding 12.7 x 10^6 m; and
    2. A "specific tensile strength" exceeding 23.5 x 10^4 m;

echnical Note:
roperties for materials described in 1013.10.b. should be etermined using SACMA recommended methods SRM 12 to 17, or ational equivalent tow tests, such as Japanese Industrial Standard IS-R-7601, Paragraph 6.6.2., and based on lot average.

c. Inorganic "fibrous or filamentary materials" with:

1. A "specific modulus" exceeding 2.54 x 10^6 m; and

2. A melting, decomposition or sublimation point exceeding 1,922 K (1,649° C) in an inert environment;

NOTE:
1013.10.c. does not embargo:

1. Discontinuous, multiphase, polycrystalline alumina fibres in chopped fibre or random matrix form, containing 3 weight percent or more silica, with a "specific modulus" of less than 10 x 10^6 m;

2. Molybdenum and molybdenum alloy fibres;

3. Boron fibres;

4. Discontinuous ceramic fibres with a melting, decomposition or sublimation point lower than 2,043 K (1,770° C) in an inert environment.

d. "Fibrous or filamentary materials":

1. Composed of any of the following:

a. Polyetherimides embargoed by 1013.8.a; or

b. Materials embargoed by 1013.8.b., c., d., e. or f.; or

2. Composed of materials embargoed by 1013.10.d.1.a. or b. and "commingled" with other fibres embargoed by 1013.10.a., b. or c.;

1013. 10. e. Resin- or pitch-impregnated fibres (prepregs), metal or carbon-coated fibres (preforms) or "carbon fibre preforms", as follows:

1. Made from "fibrous or filamentary materials" embargoed by 1013.10.a., b. or c.;

2. Made from organic or carbon "fibrous or filamentary materials":
    - a. With a "specific tensile strength" exceeding 17.7 x 10^4 m;
    - b. With a specific modulus exceeding 10.15 x 10^6 m;
    - c. Not embargoed by 1013.10.a. or b.; and
    - d. When impregnated with materials embargoed by 1013.8. or 1013.9.b., or with phenolic or epoxy resins, having a glass transition temperature (T_g) exceeding 383 K (110° C);

Technical Notes:
1. Specific modulus: Young's modulus in pascals, equivalent to N/m^2 divided by specific weight in N/m^3, measured at a temperature of (296 ± 2) K ((23 ±2)° C) and a relative humidity of (50 ±5)%.

2. Specific tensile strength: ultimate tensile strength in pascals, equivalent to N/m^2 divided by specific weight in N/m^3, measured at a temperature of (296 ±2) K ((23 ±2)° C) and a relative humidity of (50 ±5)%. (See Technical Note 2 to the Atomic Energy List.)

1014. Software

1014. 1. "Software" specially designed or modified for the "development", "production" or "use" of equipment embargoed by 1.B.

1014. 2. "Software" for the "development" of organic "matrix", metal "matrix" or carbon "matrix" laminates or "composites".

1015. Technology

1015. 1. Technology according to the General Technology Note for the "development" or "production" of equipment or materials embargoed by 1011.1.b., 1011. 1.c., 1011.2., 1011.3., 1012. or 1013. ;

1015. 2. Other technology:

1015. 2. a. Technology for the "development" or "production" of polybenzothiazoles or polybenzoxazoles;

b. Technology for the "development" or "production" of fluoroelastomer compounds containing at least one vinylether monomer;

c. Technology for the design or "production" of the following base materials or non-"composite" ceramic materials:

1. Base materials having all of the following characteristics:

    a. Any of the following compositions:

        1. Single or complex oxides of zirconium and complex oxides of silicon or aluminium;

        2. Single nitrides of boron (cubic crystalline forms);

        3. Single or complex carbides of silicon or boron; or

        4. Single or complex nitrides of silicon;

    b. Total metallic impurities, excluding intentional additions, of less than:

        1. 1,000 ppm for single oxides or carbides; or

        2. 5,000 ppm for complex compounds or single nitrides; and

        1. Average particle size equal to or less than 5 micrometre and no more than 10% of the particles larger than 10 micrometre; or

            NOTE:
            For zirconia, these limits are 1 micrometre and 5 micrometre respectively;

        a. Platelets with a length to thickness ratio exceeding 5;

        b. Whiskers with a length to diameter ratio exceeding 10 for diameters less than 2 micrometre; and

        c. Continuous or chopped fibres less than 10 micrometre in diameter;

    2. Non-"composite" ceramic materials (except abrasives) composed of the materials described in 1015.2.c.1.;

d. Technology for the "production" of aromatic polyamide fibres;

e. Technology for the installation, maintenance or repair of materials embargoed by 1013.1.;

f. Technology for the repair of "composite" structures, laminates or materials embargoed by 1011.2., 1013.7.c. or 1013.7.d

020. MATERIALS PROCESSING

021. Equipment, Assemblies and Components

021. Anti-friction bearings or bearing systems, as follows, and components therefor:

NOTE:
1021. does not embargo balls with tolerances specified by the manufacturer in accordance with ISO 3290 as grade 5 or worse.

021. 1. Ball bearings or solid roller bearings (except tapered roller bearings) having tolerances specified by the manufacturer in accordance with ABEC 7,ABEC 7P,ABEC 7T or ISO Standard Class 4 or better (or national equivalents), and having any of the following characteristics:

- a. Rings, balls or rollers made from monel or beryllium;
- b. Manufactured for use at operating temperatures above 573 K (300° C) either by using special materials or by special heat treatment; or
- c. With lubricating elements or component modifications that,according to the manufacturer's specifications, are specially designed to enable the bearings to operate at speeds exceeding 2.3 x 10^n DN;

2. Other ball bearings or solid roller bearings (except tapered roller bearings) having tolerances specified by the manufacturer in accordance with ABEC 9, ABEC 9P or ISO Standard Class 2 or better (or national equivalents);

3. Solid tapered roller bearings, having tolerances specified by the manufacturer in accordance with ANSI/ AFBMA Class 00 (inch) or Class A (metric) or better (or national equivalents) and having either of the following characteristics:

- a. With lubricating elements or component modifications that,according to the manufacturer's specifications, are specially designed to enable the bearings to operate at speeds exceeding 2.3 x 10^n DN; or
- b. Manufactured for use at operating temperatures below 219 K (-54° C) or above 423 K (150° C);

4. Gas-lubricated foil bearings manufactured for use at operating temperatures of 561 K (288° C) or higher and with a unit load capacity exceeding 1 MPa;

5. Active magnetic bearing systems;

6. Fabric-lined self-aligning or fabric-lined journal sliding bearings manufactured for use at operating temperatures below 219 K (-54° C) or above 423 K (150°C);

Technical Notes:

1. DN is the product of the bearing bore diameter in mm and the bearing rotational velocity in rpm.

2. Operating temperatures include those temperatures obtained when a gas turbine engine has stopped after operation. (For quiet running bearings, see Item 9 on the Munitions List.).

1022. Test, Inspection and Production Equipment

NOTE:
1022. does not embargo measuring interferometer systems, without closed or open loop feedback, containing a "laser" to measure slide movement errors of machine-tools, dimensional inspection machines or similar equipment.

1022. 1. "Numerical control" units, "motion control boards" specially designed for "numerical control" applications on machine tools, machine tools, and specially designed components therefor, as follows:

Technical Notes:

1. Secondary parallel contouring axes, e.g., the w-axis on horizontal boring mills or a secondary rotary axis the centre line of which is parallel to the primary rotary axis.

N.B.: Rotary axes need not rotate over 360°. A rotary axis can be driven by a linear device, e.g., a screw or a rack-and-pinion.

2. Axis nomenclature shall be in accordance with International Standard ISO 841, 'Numerical Control Machines - Axis and Motion Nomenclature'.

1022. 1. a. "Numerical control" units for machine tools, as follows:

NOTE:
1022.1.a. does not embargo "numerical control" units:

a. Modified for and incorporated in unembargoed machines; or

b. Specially designed for unembargoed machines.

022. 1. a. 1. Having more than four interpolating axes which can be coordinated simultaneously for "contouring control";

2. Having two, three or four interpolating axes which can be coordinated simultaneously for "contouring control" and:

a. Capable of "real time processing" of data to modify, during the machining operation, tool path, feed rate and spindle data by either:

1. Automatic calculation and modification of part programme data for machining in two or more axes by means of measuring cycles and access to source data; or

2. "Adaptive control" with more than one physical variable measured and processing by means of a computing model (strategy) to change one or more machining instructions to optimize the process;

b. Capable of receiving directly (on-line) and processing computer aided design (CAD) data for internal preparation of machine instructions; or

c. Capable, without modification, according to the manufacturer's technical specifications, of accepting additional boards which would permit an increase above the embargo levels specified in 1022.1., in the number of interpolating axes which can be coordinated simultaneously for "contouring control", even if they do not contain these additional boards;

1022. 1. b. "Motion control boards" specially designed for machine tools and having any of the following characteristics:

1. Interpolation in more than four axes;

2. Capable of "real time processing" as described in 1022.1.a.2.a.; or

3. Capable of receiving and processing CAD data as described in 1022.1.a.2.b.;

c. Machine tools, as follows, for removing or cutting metals, ceramics or composites, which, according to the manufacturer's technical specifications, can be equipped with electronic devices for simultaneous "contouring control" in two or more axes:

1. Machine tools for turning, grinding, milling or any combination thereof which:

    a. Have two or more axes which can be coordinated simultaneously for "contouring control"; and

    b. Have any of the following characteristics:

        1. Two or more contouring rotary axes;

Technical Note:
The c axis on jig grinders used to maintain grinding wheels normal to the work surface is not considered a contouring rotary axis.

        2. One or more contouring "tilting spindles";

NOTE:
1022.1.c.1.b.2. applies to machine tools for grinding or milling only.

        3. "Camming" (axial displacement) in one revolution of the spindle less (better) than 0.0006 mm total indicator reading (TIR);

NOTE:
1022.1.c.1.b.3. applies to machine tools for turning only.

        4. "Run out" (out-of-true running) in one revolution of the spindle less (better) than 0.0006 mm indicator reading (TIR);

        5. The positioning accuracies, with all compensations available, are less (better) than:

            a. 0.001° on any rotary axis; or

b. 1. 0.004 mm along any linear axis for grinding machines;

2. 0.006 mm along any linear axis for turning or milling machines; or

NOTE:
1022.1.c.1.b.5. does not embargo milling or turning machine tools with a positioning accuracy along one axis, with all compensations available, equal to or more (worse) than 0.005 mm.

echnical Note:
ne positioning accuracy of "numerically controlled" machine tools s to be determined and presented in accordance with ISO/DIS 230/2, aragraph 2.13, in conjunction with the requirements below:

a. Test conditions (paragraph 3):

1. For 12 hours before and during measurements, the machine tool and accuracy measuring equipment will be kept at the same ambient temperature. During the premeasurement time the slides of the machine will be continuously cycled in the same manner that the accuracy measurements will be taken;

2. The machine shall be equipped with any mechanical, electronic, or software compensation to be exported with the machine;

3. Accuracy of measuring equipment for the measurements shall be at least four times more accurate than the expected machine tool accuracy;

4. Power supply shall be as follows:

   a. Line voltage variation shall not exceed ±10% of nominal rated voltage;

   b. Frequency variation shall not exceed ±2 Hz of normal frequency;

   c. Lineouts or interrupted service are not permitted.

b. Test programme (paragraph 4):

1. Feed rate (velocity of slides) during measurement shall be the rapid traverse rate;

N.B.:
In the case of machines tools which generate optical quality surfaces, the feed rate shall be equal to or less than 50 mm per minute;

2. Measurements shall be made in an incremental manner from one limit of the axis travel to the other without returning to the starting position for each move or target position;

3. Axes not being measured shall be retained at mid travel during test of an axis.

c. Presentation of test results (paragraph 2): The results of the measurements must include:

1. positioning accuracy (A); and
2. The mean reversal error (B).

1022. 1. c. 1. b. 6. a. A positioning accuracy less (better) than 0.007 mm; and
b. A slide motion from rest for all slides within 20% of a motion command input for inputs of less than 0.5 micrometre;

Technical Note:
Minimum increment of motion test (slide motion from rest): The test is conducted only if the machine tool is equipped with a control unit the minimum increment of which is less (better) than 0.5 micrometre. Prepare the machine for testing in accordance with ISO 230/2 paragraphs 3.1, 3.2, 3.3. Conduct the test on each axis (slide) of the machine tool as follows:

a. Move the axis over at least 50% of the maximum travel in plus and minus directions at maximum feed rate, rapid traverse rate or jog control;

b. Wait at least 10 seconds;

c. With manual data input, input the minimum programmable increment of the control unit;

d. Measure the axis movement;

e. Clear the control unit with the servo null, reset or whatever clears any signal (voltage) in the servo loop;

f. Repeat steps b - e five times, twice in the same direction of the axis travel and three times in the opposite direction of travel for a total of six test points;

g. If the axis movement is between 80% and 120% of the minimum programmable input for four of the six test points, the machine is embargoed.

For rotary axes, the measurement is taken 200 mm from the centre of rotation.

NOTES:

1. 1022.1.c.1. does not embargo cylindrical external, internal, and external-internal grinding machines having all of the following characteristics:

   a. Shoe-type grinding machines;
   b. Limited to cylindrical grinding;
   c. A maximum workpiece outside diameter or length of 150 mm;
   d. Only two axes which can be coordinated simultaneously for "contouring control"; and
   e. No contouring c axis.

2. 1022.1.c.1. does not embargo machines designed specifically as jig grinders having both of the following characteristics:

   a. Axes limited to x, y, c and a, where the c axis is used to maintain the grinding wheel normal to the work surface and the a axis is configured to grind barrel cams; and

   b. A spindle "run out" not less (not better) than 0.0006 mm.

3. 1022.1.c.1. does not embargo tool or cutter grinding machines having all of the following characteristics:

   a. Shipped as a complete system with "software" specially designed for the production of tools or cutters;

   b. No more than two rotary axes which can be coordinated simultaneously for "contouring control";

   c. "Run out" (out-of-true running) in one revolution of the spindle not less (not better) than 0.0006 mm TIR; and

   d. The positioning accuracies, with all compensations available, are of at least:

      1. 0.004 mm along any linear axis for overall positioning; or

      2. 0.001° on any rotary axis.

4. The Committee will favourably consider the export of turning machines embargoed by 1022.1.c.1. provided:

a. They are not intended for use in nuclear related activities; and

b. They have all of the following characteristics:

   1. Only two axes which can be coordinated simultaneously for "contouring control";

   2. The positioning accuracy, with all compensations available, is not less (not better) than 0.002 mm per 300 mm of travel;

   3. Geometric alignment of the axes, parallel or perpendicular to each other, is not less (not better) than 0.001 mm per 300 mm of travel;

   4. Slide travel in both axes is not longer than 400 mm;

   5. "Run out" (out-of-true running) in one revolution of the spindle is more (worse) than 0.0004 mm TIR; and

   6. "Camming" (axial displacement) in one revolution of the spindle is more (worse) than 0.0004 mm TIR.

The export of equipment described in this Note will be approved if no objection was filed within four weeks of the receipt of complete information on the case.

1022. 1. c. 2. Electrical discharge machines (EDM) of the wire feed type which have five or more axes which can be coordinated simultaneously for "contouring control";

3. Electrical discharge machines (EDM) of the non-wire type which have two or more rotary axes which can be coordinated simultaneously for "contouring control";

4. Machine tools for removing metals, ceramics or composites:

   a. By means of:

      1. Water or other liquid jets, including those employing abrasive additives;

      2. Electron beam; or

      3. "Laser" beam; and

   b. Having two or more rotary axes which:

      1. Can be coordinated simultaneously for "contouring control"; and

2. Have a positioning accuracy of less (better) than 0.003°;

1022. 2. Non-"numerically controlled" machine tools for generating optical quality surfaces, as follows:

a. Turning machines using a single point cutting tool and having all of the following characteristics:

1. Slide positioning accuracy less (better) than 0.0005 mm per 300 mm of travel;

2. Bidirectional slide positioning repeatability less (better) than 0.00025 mm per 300 mm of travel;

3. Spindle "run out" and "camming" less (better) than 0.0004 mm TIR;

4. Angular deviation of the slide movement less (better) than 2 seconds of arc, TIR, over full travel; and

5. Slide perpendicularity less (better) than 0.001 mm per 300 mm of travel;

Technical Note:
The bidirectional slide positioning repeatability (R) of an axis is the maximum value of the repeatability of positioning at any position along or around the axis determined using the procedure and under the conditions specified in part 2.11 of ISO 230/2: 1988.

b. Fly cutting machines having both of the following characteristics:

1. Spindle "run out" and "camming" less (better) than 0.0004 mm TIR; and

2. Angular deviation of slide movement (yaw, pitch and roll) less (better) than 2 seconds of arc, TIR, over full travel;

1022. 3. "Numerically controlled" or manual machine tools specially designed for cutting, finishing, grinding or honing either of the following classes of bevel or parallel axis hardened (Rc = 40 or more) gears, and specially designed components therefor:

a. Hardened bevel gears finished to a quality of better than AGMA 13 (equivalent to ISO 1328 class 4); or

b. Hardened spur, helical and double-helical gears with a pitch diameter exceeding 1,250 mm and a face width of 15% of pitch diameter or larger finished to a quality of to AGMA 14 or better (equivalent to ISO 1328 class 3);

1022. 4. Hot "isostatic presses", as follows, and specially designed dies, moulds, components, accessories and controls therefor:

a. Having a controlled thermal environment within the closed cavity and possessing a chamber cavity with an inside diameter of 406 mm or more; and

b. Having:

1. A maximum working pressure exceeding 207 MPa;

2. A controlled thermal environment exceeding 1,773 K (1,500° C); or

3. A facility for hydrocarbon impregnation and removal of resultant gaseous degradation products;

Technical Note:
The inside chamber dimension is that of the chamber in which both the working temperature and the working pressure are achieved and does not include fixtures. That dimension will be the smaller of either the inside diameter of the pressure chamber or the inside diameter of the insulated furnace chamber, depending on which of the two chambers is located inside the other.

1022. 5. Equipment specially designed for the deposition,processing and in-process control of inorganic overlays, coatings and surface modifications, as follows, for non-electronic substrates, by processes shown in the Table and associated Notes following 1025.3.d, and specially designed automated handling, positioning, manipulation and control components therefor:

a. "Stored programme controlled" chemical vapour deposition (CVD) production equipment with both of the following:
1. Process modified for one of the following:

a. Pulsating CVD;

b. Controlled nucleation thermal decomposition (CNTD); or

c. Plasma enhanced or plasma assisted CVD; and

2. Either of the following:

   a. Incorporating high vacuum (equal to or less than 0.01 Pa) rotating seals; or
   b. Incorporating in situ coating thickness control;

b. "Stored programme controlled" ion implantation production equipment having beam currents of 5 mA or more;

c. "Stored programme controlled" electron beam physical vapour deposition (EB-PVD) production equipment incorporating:

1. Power systems rated for over 80 kW;

2. A liquid pool level "laser" control system which regulates precisely the ingots feed rate; and

3. A computer controlled rate monitor operating on the principle of photo-luminescence of the ionised atoms in the evaporant stream to control the deposition rate of a coating containing two or more elements;

d. "Stored programme controlled" plasma spraying production equipment having either of the following characteristics:

1. Operating at reduced pressure controlled atmosphere (equal to or less than 10 kPa measured above and within 300 mm of the gun nozzle exit) in a vacuum chamber capable of 0.01 Pa prior to the spraying process; or

2. Incorporating in situ coating thickness control;

e. "Stored programme controlled" sputter deposition production equipment capable of current densities of 0.1 mA/mm^2 or higher at a deposition rate of 15 micrometre/hr or more;

f. "Stored programme controlled" cathodic arc deposition production equipment incorporating a grid of electromagnets for steering control of the arc spot on the cathode;

g. "Stored programme controlled" ion plating production equipment allowing for the in situ measurement of:

1. Coating thickness on the substrate and rate control; or

2. Optical characteristics;

NOTE:
1022.5.g. does not embargo standard ion plating coating equipment for cutting or machining tools.

1022. 6. Dimensional inspection or measuring systems or equipment, as follows:

a. Computer controlled, "numerically controlled" or "stored programme controlled" dimensional inspection machines, having both of the following characteristics:

1. Two or more axes; and

2. A one dimensional length "measurement uncertainty" equal to or less than (1.25 + L/1,000) micrometre tested with a probe with an "accuracy" of less (better) than 0.2 micrometre (L is the measured length in mm);

b. Linear and angular displacement measuring instruments, as follows:

1. Linear measuring instruments having any of the following characteristics:

a. Non-contact type measuring systems with a "resolution" equal to or less (better) than 0.2 micrometre within a measuring range up to 0.2 mm;

b. Linear voltage differential transformer systems with both of the following characteristics:

1. "Linearity" equal to or less (better) than 0.1% within a measuring range up to 5 mm; and

2. Drift equal to or less (better) than 0.1% per day at a standard ambient test room temperature ±1 K; or

c. Measuring systems having both of the following characteristics:

1. Containing a "laser"; and

2. Maintaining, for at least 12 hours, over a temperature range of ±1 K around a standard temperature and at a standard pressure:

a. A "resolution" over their full scale of 0.1 micrometre or less (better); and

b. A "measurement uncertainty" equal to or less (better) than (0.2 + L/2,000) micrometre (L is the measured length in mm);

2. Angular measuring instruments having an "angular position deviation" equal to or less (better) than 0.00025°;

NOTE:
1022.6.b.2. does not embargo optical instruments, such as autocollimators, using collimated light to detect angular displacement of a mirror.

c. Systems for simultaneous linear-angular inspection of hemishells, having both of the following characteristics:

1. "Measurement uncertainty" along any linear axis equal to or less (better) than 3.5 micrometre per 5 mm; and

2. "Angular position deviation" equal to or less (better) than 0.02°;

d. Equipment for measuring surface irregularities, by measuring optical scatter as a function of angle, with a sensitivity of 0.5 nm or less (better);

Technical Notes:
1. The probe used in determining the "measurement uncertainty" of a dimensional inspection system shall be as described in VDI/VDE 2617 Parts 2, 3 and 4.

2. All measurement values in 1022.6. represent permissible positive and negative deviations from the real value, i.e., not total band.

NOTES:

1. Machine tools which can be used as measuring machines are embargoed if they meet or exceed the criteria specified for the machine tool function or the measuring machine function.

2. A machine described in 1022.6. is embargoed if it exceeds the embargo threshold anywhere within its operating range.

3. May be permitted, as administrative exceptions, the shipment of equipment embargoed by 1022.6.b.1. to civil end-users not engaged in aerospace or nuclear activities.

1022. 7. "Robots", as follows, and specially designed controllers and "end-effectors" therefor:

a. Capable in real time of full three-dimensional image processing or full three-dimensional scene analysis to generate or modify "programmes" or to generate or modify numerical programme data;

NOTE:
The scene analysis limitation does not include approximation of the third dimension by viewing at a given angle, or limited grey scalen interpretation for the perception of depth or texture for the approved tasks (2 1/2 D).

b. Specially designed to comply with national safety standards applicable to explosive munitions environments; or

c. Specially designed or rated as radiation-hardened beyond that necessary to withstand normal industrial (i.e., non-nuclear industry) ionizing radiation;

1022. 8. Assemblies, units or inserts specially designed for machine tools, or for equipment embargoed by 1022.6. or 7., as follows:

a. Spindle assemblies, consisting of spindles and bearings as a minimal assembly, with radial ("run out") or axial ("camming") axis motion in one revolution of the spindle less (better) than 0.0006 mm total indicator reading (TIR);

b. Linear position feedback units (e.g., inductive type devices, graduated scales, infrared systems or "laser" systems) having an overall "accuracy" less (better) than (800 + (600 x L x 10^{-3})) nm (L equals the effective length in mm);

c. Rotary position feedback units, e.g., inductive type devices, graduated scales, infrared systems or "laser" systems, having an "accuracy" less (better) than 0.00025°;

d. Slide way assemblies consisting of a minimal assembly of ways, bed and slide having all of the following characteristics:

1. A yaw, pitch or roll of less (better) than 2 seconds of arc TIR (reference: ISO/DIS 230/1) over full travel;

2. A horizontal straightness of less (better) than 2 micrometre per 300 mm length; and

3. A vertical straightness of less (better) than 2 micrometre per 300 mm length;

e. Single point diamond cutting tool inserts, having all of the following characteristics:

1. Flawless and chip-free cutting edge when magnified to 400 times in any direction;

2. Cutting radius from 0.1 to 5 mm inclusive; and

3. Cutting radius out-of-roundness less (better) than 0.002 mm TIR;

1022. 9. Specially designed printed circuit boards with mounted components and "software" therefor, or "compound rotary tables", capable of upgrading, according to the manufacturer's specifications, "numerical control" unit machine tools or feed- back devices to or above the levels specified in 1022.;

1023. Materials

None.

1024. Software

1024. 1. "Software" specially designed or modified for the "development", "production" or "use" of equipment embargoed by 1021. or 1022.;

1024. 2. Specific "software", as follows:

a. "Software" to provide "adaptive control" and having both of the following characteristics:

1. For "flexible manufacturing units" (FMUs) which consist at least of equipment described in b.1. and b.2. of the definition of "flexible manufacturing unit"; and

2. Capable of generating or modifying, in "real time processing", "programmes" or data by using the signals obtained simultaneously by means of at least two detection techniques, such as:
   a. Machine vision (optical ranging);
   b. Infrared imaging;
   c. Acoustical imaging (acoustical ranging);
   d. Tactile measurement;
   e. Inertial positioning;
   f. Force measurement;
   g. Torque measurement;

NOTE:
1024.2.a. does not embargo "software" which only provides rescheduling of functionally identical equipment within "flexible units" using pre-stored part programmes and a pre-stored strategy for the distribution of the part programmes.

b. "Software" for electronic devices other than those described in 1022.1.a. or b., which provides the "numerical control" capability of the equipment embargoed by 1022.1;

1025. Technology

1025. 1. Technology according to the General Technology Note for the "development" of equipment or "software" embargoed by 1021., 1022. or 1024.

1025. 2. Technology according to the General Technology Note for the "production" of equipment embargoed by 1021. or 1022.;

1025. 3. Other technology, as follows:
a. Technology:

1. For the "development" of interactive graphics as an integrated part in "numerical control" units for preparation or modification of programmes;
2. For the "development" of generators of machine tool instructions from design data residing inside "numerical control" units;
3. For the "development" of integration "software" for incorporation of expert systems for advanced decision support of shop floor operations into "numerical control" units;

b. Technology for metal-working manufacturing processes, as follows:

1. Technology for the design of tools, dies or fixtures specially designed for the following processes:
    a. "Superplastic forming";
    b. "Diffusion bonding";
    c. "Direct-acting hydraulic pressing";
2. Technical data consisting of process methods or parameters as listed below used to control:
    a. "Superplastic forming" of aluminium alloys, titanium alloys or "superalloys":
        1. Surface preparation;
        2. Strain rate;
        3. Temperature;
        4. Pressure;
    b. "Diffusion bonding" of "superalloys" or titanium alloys:
        1. Surface preparation;
        2. Temperature;
        3. Pressure;

c. "Direct-acting hydraulic pressing" of aluminium alloys or titanium alloys:

  1. Pressure;

  2. Cycle time;

d. "Hot isostatic densification" of titanium alloys, aluminium alloys or "superalloys":

  1. Temperature;

  2. Pressure;

  3. Cycle time;

c. Technology for the "development" or "production" of hydraulic stretch-forming machines and dies therefor, for the manufacture of airframe structures;

d. Technology for:

- The application of inorganic overlay coatings or inorganic surface modification coatings, specified in column 3 of the following Table;
- Non-electronic substrates, specified in column 2 of the following Table;
- By processes specified in column 1 of the following Table and defined in the Technical Note;

TABLE - DEPOSITION TECHNIQUES

	1.Coating Process	2.Substrate	3.Resultant coating
A.	Chemical Vapour Deposition (CVD)	"Superalloys"	Aluminides for internal passages
		Ceramics and Low-expansion glasses (14)	Silicides Carbides Dielectric layers (15)
		Carbon-carbon, Ceramic and Metal "matrix" "composites"	Silicides Carbides Refractory metals Mixtures thereof (4) Dielectric layers (15) Aluminides Alloyed aluminides (2)
		Cemented tungsten carbide (16), Silicon carbide	Carbides Tungsten Mixtures thereof (4) Dielectric layers (15)
		Molybdenum and Molybdenum alloys	Dielectric layers (15)
		Beryllium and Beryllium alloys	Dielectric layers (15)
		Sensor window materials (9)	Dielectric layers (15)
B.	Thermal-Evaporation Physical Vapour Deposition (TE-PVD)		
B.1.	Physical Vapour Deposition (PVD): Electron-Beam (EB-PVD)	"Superalloys"	Alloyed silicides Alloyed aluminides (2) MCrAlX (5) Modified zirconia (12) Silicides Aluminides Mixtures thereof (4)
		Ceramics and Low-expansion glasses (14)	Dielectric layers (15)

	1. Coating Process	2. Substrate	3. Resultant coating
		Corrosion resistant steel (7)	MCrAlX (5) Modified zirconia (12) Mixtures thereof (4)
		Carbon-carbon, Ceramic and Metal "matrix" "composites	Silicides Carbides Refractory metals Mixtures thereof (4) Dielectric layers (15)
		Cemented tungsten carbide (16), Silicon carbide	Carbides Tungsten Mixtures thereof (4) Dielectric layers (15)
		Molybdenum and Molybdenum alloys	Dielectric layers (15)
		Beryllium and Beryllium alloys	Dielectric layers (15) Borides
		Sensor window materials (9)	Dielectric layers (15)
		Titanium alloys (13)	Borides Nitrides
B.2.	Ion assisted resistive heating Physical Vapour Deposition (Ion Plating)	Ceramics and Low-expansion glasses (14)	Dielectric layers (15)
		Carbon-carbon, Ceramic and Metal "matrix" "composites"	Dielectric layers (15)
		Cemented tungsten carbide (16), Silicon carbide	Dielectric layers (15)
		Molybdenum and Molybdenum alloys	Dielectric layers (15)
		Beryllium and Beryllium alloys	Dielectric layers (15)
		Sensor window materials (9)	Dielectric layers (15)

	1.Coating Process	2.Substrate	3.Resultant coating
B.3.	Physical Vapour Deposition: "laser" evaporation	Ceramics and Low-expansion glasses (14)	Silicides Dielectric layers (15)
		Carbon-carbon, Ceramic and Metal "matrix" "composites"	Dielectric layers (15)
		Cemented tungsten carbide (16), Silicon carbide	Dielectric layers (15)
		Molybdenum and Molybdenum alloys	Dielectric layers (15)
		Beryllium and Beryllium alloys	Dielectric layers (15)
		Sensor window materials (9)	Dielectric layers (15) Diamond-like carbon
B.4.	Physical Vapour Deposition: cathodic arc discharge	"Superalloys"	Alloyed silicides Alloyed aluminides (2) MCrA1X (5)
		Polymers (11) and Organic "matrix" "composites"	Borides Carbides Nitrides
C.	Pack cementation (see A above for out-of-pack cementation) (10)	Carbon-carbon, Ceramic and Metal "matrix" "composites"	Silicides Carbides Mixtures thereof (4)
		Titanium alloys (13)	Silicides Aluminides Alloyed aluminides (2)
		Refractory metals and alloys (8)	Silicides Oxides

	1. Coating Process	2. Substrate	3. Resultant coating
D.	Plasma spraying	"Superalloys"	MCrAlX (5) Modified zirconia (12) Mixtures thereof (4) Abradable Nickel-Graphite Abradable Ni-Cr-Al-Bentonite Abradable Al-Si-Polyester Alloyed aluminides (2)
		Aluminium alloys (6)	MCrAlX (5) Modified zirconia (12) Silicides Mixtures thereof (4)
		Refractory metals and alloys (8)	Aluminides Silicides Carbides
		Corrosion resistant steel (7)	MCrAlX (5) Modified zirconia (12) Mixtures thereof (4)
		Titanium alloys (13)	Carbides Aluminides Silicides Alloyed aluminides (2) Abradable Nickel-Graphite Abradable Ni-Cr-Al-Bentonite Abradable Al-Si-Polyester
E.	Slurry Deposition	Refractory metals and alloys (8)	Fused silicides Fused aluminides except for resistance heating elements
		Carbon-carbon, Ceramic and Metal "matrix" "composites"	Silicides Carbides Mixtures thereof (4)

	1. Coating Process	**2. Substrate**	**3. Resultant coating**
F.	Sputter Deposition	"Superalloys"	Alloyed silicides Alloyed aluminides (2) Noble metal modified aluminides (3) MCrAlX (5) Modified zirconia (12) Platinum Mixtures thereof (4)
		Ceramics and Low-expansion glasses (14)	Silicides Platinum Mixtures thereof (4) Dielectric layers (15)
		Titanium alloys (13)	Borides Nitrides Oxides Silicides Aluminides Alloyed aluminides (2) Carbides
		Carbon-carbon, Ceramic and Metal "matrix" "composites"	Silicides Carbides Refractory metals Mixtures thereof (4) Dielectric layers (15)
		Cemented tungsten carbide (16), Silicon carbide	Carbides Tungsten Mixtures thereof (4) Dielectric layers (15)
		Molybdenum and Molybdenum alloys	Dielectric layers (15)
		Beryllium and Beryllium alloys	Borides Dielectric layers (15)
		Sensor window materials (9)	Dielectric layers (15)
		Refractory metals and alloys (8)	Aluminides Silicides Oxides Carbides
G.	Ion Implantation	High temperature bearing steels	Additions of Chromium, Tantalum or Niobium (Columbium)

1. Coating Process	2. Substrate	3. Resultant coating
	Titanium alloys (13)	Borides Nitrides
	Beryllium and Beryllium alloys	Borides
	Cemented tungsten carbide (16)	Carbides Nitrides

- DEPOSITION TECHNIQUES - NOTES

1. The term 'coating process' includes coating repair and refurbishing as well as original coating.

2. The term 'alloyed aluminide coating' includes single or multiple-step coatings in which an element or elements are deposited prior to or during application of the aluminide coating, even if these elements are deposited by another coating process. It does not, however, include the multiple use of single-step pack cementation processes to achieve alloyed aluminides.

3. The term 'noble metal modified aluminide' coating includes multiple-step coatings in which the noble metal or noble metals are laid down by some other coating process prior to application of the aluminide coating.

4. Mixtures consist of infiltrated material, graded compositions, co-deposits and multilayer deposits and are obtained by one or more of the coating processes specified in the Table.

5. MCrAlX refers to a coating alloy where M equals cobalt, iron, nickel or combinations thereof and X equals hafnium, yttrium, silicon, tantalum in any amount or other intentional additions over 0.01 weight percent in various proportions and combinations, except:

   a. CoCrAlY coatings which contain less than 22 weight percent of chromium, less than 7 weight percent of aluminium and less than 2 weight percent of yttrium;

   b. CoCrAlY coatings which contain 22 to 24 weight percent of chromium, 10 to 12 weight percent of aluminium and 0.5 to 0.7 weight percent of yttrium; or

   c. NiCrAlY coatings which contain 21 to 23 weight percent of chromium, 10 to 12 weight percent of aluminium and 0.9 to 1.1 weight percent of yttrium.

6. The term 'Aluminium alloys' refers to alloys having an ultimate tensile strength of 190 MPa or more measured at 293 K (20° C).

7. The term 'Corrosion resistant steel' refers to AISI (American Iron and Steel Institute) 300 series or equivalent national standard steels.

8. Refractory metals consist of the following metals and their alloys: niobium (columbium), molybdenum, tungsten and tantalum.

9. Sensor window materials, as follows: alumina, silicon, germanium, zinc sulphide, zinc selenide, gallium arsenide and the following metal halides: potassium iodide, potassium fluoride, or sensor window materials of more than 40 mm diameter for thallium bromide and thallium chlorobromide.

10. Technology for single-step pack cementation of solid airfoils is not embargoed by Category 1020.

11. Polymers, as follows: polyimide, polyester, polysulphide, polycarbonates and polyurethanes.

12. Modified zirconia refers to additions of other metal oxides, e.g., calcia, magnesia, yttria, hafnia, rare earth oxides, etc., to zirconia in order to stabilise certain crystallographic phases and phase compositions. Thermal barrier coatings made of zirconia, modified with calcia or magnesia by mixing or fusion, are not embargoed.

13. Titanium alloys refers to aerospace alloys having an ultimate tensile strength of 900 MPa or more measured at 293 K (20° C).

14. Low-expansion glasses refers to glasses which have a coefficient of thermal expansion of 1×10^{-7} K^{-1} or less measured at 293 K (20° C).

15. Dielectric layers are coatings constructed of multi-layers of insulator materials in which the interference properties of a design composed of materials of various refractive indices are used to reflect, transmit or absorb various wavelength bands. Dielectric layers refer to more than four dielectric layers or dielectric/metal "composite" layers.

16. Cemented tungsten carbide does not include cutting and forming tool materials consisting of tungsten carbide/(cobalt,nickel), titanium carbide/(cobalt, nickel), chromium carbide/nickel-chromium and chromium carbide/nickel.

Technical Note:
Processes specified in Column 1 of the Table are defined as follows:

16. a. Chemical Vapour Deposition (CVD) is an overlay coating or surface modification coating process wherein a metal, alloy, "composite", dielectric or ceramic is deposited upon a heated substrate. Gaseous reactants are decomposed or combined in the vicinity of a substrate resulting in the deposition of the desired elemental, alloy or compound material on the substrate. Energy for this decomposition or chemical reaction process may be provided by the heat of the substrate, a glow discharge plasma, or "laser" irradiation.

N.B.:

1. CVD includes the following processes: directed gas flow out-of-pack deposition, pulsating CVD, controlled nucleation thermal decomposition (CNTD), plasma enhanced or plasma assisted CVD processes.
2. Pack denotes a substrate immersed in a powder mixture.
3. The gaseous reactants used in the out-of-pack process are produced using the same basic reactions and parameters as the pack cementation process, except that the substrate to be coated is not in contact with the powder mixture.

16. b. Thermal Evaporation-Physical Vapour Deposition (TE-PVD) is an overlay coating process conducted in a vacuum with a pressure less than 0.1 Pa wherein a source of thermal energy is used to vaporize the coating material. This process results in the condensation, or deposition, of the evaporated species onto appropriately positioned substrates. The addition of gases to the vacuum chamber during the coating process to synthesize compound coatings is an ordinary modification of the process. The use of ion or electron beams, or plasma, to activate or assist the coating's deposition is also a common modification in this technique. The use of monitors to provide in-process measurement of optical characteristics and thickness of coatings can be a feature of these processes. Specific TE-PVD processes are as follows:

1. Electron Beam PVD uses an electron beam to heat and evaporate the material which forms the coating;

2. Resistive Heating PVD employs electrically resistive heating sources capable of producing a controlled and uniform flux of evaporated coating species;

3. "Laser" Evaporation uses either pulsed or continuous wave "laser" beams to heat the material which forms the coating;

4. Cathodic Arc Deposition employs a consumable cathode of the material which forms the coating and has an arc discharge established on the surface by a momentary contact of a ground trigger. Controlled motion of arcing erodes the cathode surface creating a highly ionized plasma. The anode can be either a cone attached to the periphery of the cathode, through an insulator, or the chamber. Substrate biasing is used for non line-of-sight deposition.

   N.B.: This definition does not include random cathodic arc deposition with non-biased substrates.

16. c. Ion Plating is a special modification of a general TE-PVD process in which a plasma or an ion source is used to ionize the species to be deposited, and a negative bias is applied to the substrate in order to facilitate the extraction of the species to be deposited from the plasma. The introduction of reactive species, evaporation of solids within the process chamber, and the use of monitors to provide in-process measurement of optical characteristics and thicknesses of coatings are ordinary modifications of the process.

16. d. Pack Cementation is a surface modification coating or overlay coating process wherein a substrate is immersed in a powder mixture (a pack), that consists of:

   1. The metallic powders that are to be deposited (usually aluminium, chromium, silicon or combinations thereof);

   2. An activator (normally a halide salt); and

   3. An inert powder, most frequently alumina. The substrate and powder mixture is contained within a retort which is heated to between 1,030 K (757° C) to 1,375 K (1,102° C) for sufficient time to deposit the coating.

16. e. Plasma Spraying is an overlay coating process wherein a gun (spray torch) which produces and controls a plasma accepts powder or wire coating materials, melts them and propels them towards a substrate, whereon an integrally bonded coating is formed. Plasma spraying constitutes either low pressure plasma spraying or high velocity plasma spraying carried out underwater.

N.B.: 1. Low pressure means less than ambient atmospheric pressure.

2. High velocity refers to nozzle-exit gas velocity exceeding 750 m/s calculated at 293 K (20° C) at 0.1 MPa.

16. f. Slurry Deposition is a surface modification coating or overlay coating process wherein a metallic or ceramic powder with an organic binder is suspended in a liquid and is applied to a substrate by either spraying, dipping or painting, subsequent air or oven drying, and heat treatment to obtain the desired coating.

16. g. Sputter Deposition is an overlay coating process based on a momentum transfer phenomenon, wherein positive ions are accelerated by an electric field towards the surface of a target (coating material). The kinetic energy of the impacting ions is sufficient to cause target surface atoms to be released and deposited on an appropriately positioned substrate.

N.B.:

1. The Table refers only to triode, magnetron or reactive sputter deposition which is used to increase adhesion of the coating and rate of deposition and to radio frequency (RF) augmented sputter deposition used to permit vapourisation of non-metallic coating materials.

2. Low-energy ion beams (less than 5 keV) can be used to activate the deposition.

16. h. Ion Implantation is a surface modification coating process in which the element to be alloyed is ionized, accelerated through a potential gradient and implanted into the surface region of the substrate. This includes processes in which ion implantation is performed simultaneously with electron beam physical vapour deposition or sputter deposition.

Statement of Understanding

It is understood that the following technical information, accompanying the table of deposition techniques, is for use as appropriate.

1. Technology for pretreatments of the substrates listed in the Table, as follows:
    a. Chemical stripping and cleaning bath cycle parameters, as follows:
        1. Bath composition
            a. For the removal of old or defective coatings, corrosion product or foreign deposits;
            b. For preparation of virgin substrates;
        2. Time in bath;
        3. Temperature of bath;
        4. Number and sequences of wash cycles;
    b. Visual and macroscopic criteria for acceptance of the cleaned part;
    c. Heat treatment cycle parameters, as follows:
        1. Atmosphere parameters, as follows:
            a. Composition of the atmosphere;
            b. Pressure of the atmosphere;
        2. Temperature for heat treatment;
        3. Time of heat treatment;
    d. Substrate surface preparation parameters, as follows:
        1. Grit blasting parameters, as follows:
            a. Grit composition;
            b. Grit size and shape;
            c. Grit velocity;
        2. Time and sequence of cleaning cycle after grit blast;
        3. Surface finish parameters;

e. Masking technique parameters, as follows:

  1. Material of mask;

  2. Location of mask;

16.h.2. Technology for in situ quality assurance techniques for evaluation of the coating processes listed in the Table, as follows:

a. Atmosphere parameters, as follows:

  1. Composition of the atmosphere;
  2. Pressure of the atmosphere;

b. Time parameters;

c. Temperature parameters;

d. Thickness parameters;

e. Index of refraction parameters;

16.h.3. Technology for post deposition treatments of the coated substrates listed in the Table, as follows:

a. Shot peening parameters, as follows:

  1. Shot composition;
  2. Shot size;
  3. Shot velocity;

b. Post shot peening cleaning parameters;

c. Heat treatment cycle parameters, as follows:

  1. Atmosphere parameters, as follows:

    a. Composition of the atmosphere;

    b. Pressure of the atmosphere;

  2. Time-temperature cycles;

d. Post heat treatment visual and macroscopic criteria for acceptance of the coated substrates;

16.h.4. Technology for quality assurance techniques for the evaluation of the coated substrates listed in the Table,as follows:

- a. Statistical sampling criteria;
- b. Microscopic criteria for:
  - 1. Magnification;
  - 2. Coating thickness uniformity;
  - 3. Coating integrity;
  - 4. Coating composition;
  - 5. Coating and substrates bonding;
  - 6. Microstructural uniformity;
- c. Criteria for optical properties assessment:
  - 1. Reflectance;
  - 2. Transmission;
  - 3. Absorption;
  - 4. Scatter;

16.h.5. Technology and parameters related to specific coating and surface modification processes listed in the Table, as follows:

- a. For Chemical Vapour Deposition:
  - 1. Coating source composition and formulation;
  - 2. Carrier gas composition;
  - 3. Substrate temperature;
  - 4. Time-temperature-pressure cycles;
  - 5. Gas control and part manipulation;
- b. For Thermal Evaporation - Physical Vapour Deposition:
  - 1. Ingot or coating material source composition;
  - 2. Substrate temperature;
  - 3. Reactive gas composition;

4. Ingot feed rate or material vapourisation rate;
5. Time-temperature-pressure cycles;
6. Beam and part manipulation;
7. "Laser" parameters, as follows:
    a. Wave length;
    b. Power density;
    c. Pulse length;
    d. Repetition ratio;
    e. Source;
    f. Substrate orientation;

c. For Pack Cementation:
    1. Pack composition and formulation;
    2. Carrier gas composition;
    3. Time-temperature-pressure cycles;

d. For Plasma Spraying:
    1. Powder composition, preparation and size distributions;
    2. Feed gas composition and parameters;
    3. Substrate temperature;
    4. Gun power parameters;
    5. Spray distance;
    6. Spray angle;
    7. Cover gas composition, pressure and flow rates;
    8. Gun control and part manipulation;

e. For Sputter Deposition:

  1. Target composition and fabrication;
  2. Geometrical positioning of part and target;
  3. Reactive gas composition;
  4. Electrical bias;
  5. Time-temperature-pressure cycles;
  6. Triode power;
  7. Part manipulation;

f. For Ion Implantation:

  1. Beam control and part manipulation;
  2. Ion source design details;
  3. Control techniques for ion beam and deposition rate parameters;
  4. Time-temperature-pressure cycles.

g. For Ion Plating:

  1. Beam control and part manipulation;
  2. Ion source design details
  3. Control techniques for ion beam and deposition rate parameters;
  4. Time-temperature-pressure cycles;
  5. Coating material feed rate and vapourisation rate;
  6. Substrate temperature;
  7. Substrate bias parameters.

1030. ELECTRONICS

1031. Equipment, Assemblies and Components

1031. NOTES:

1. The embargo status of equipment, devices and components described in 1031, other than those described in 1031.1.a.3.to 10., which are specially designed or which have the same functional characteristics as other equipment is determined by the embargo status of the other equipment.

2. The embargo status of integrated circuits described in 1031.1.a.3.to 9. which are unalterably programmed or designed for a specific function is determined by the embargo status of the other equipment.
   N.B.: When the manufacturer or applicant cannot determine the embargo status of the other equipment, the embargo status of the integrated circuits is determined in 1031.1.a.3. to 9.

1031. 1. Electronic devices and components:

a. General purpose integrated circuits, as follows:

NOTES:
1. The embargo status of wafers (finished or unfinished), in which the function has been determined, is to be evaluated against the parameters of 1031.1.a.

2. Integrated circuits include the following types:
   "Monolithic integrated circuits";
   "Hybrid integrated circuits";
   "Multichip integrated circuits";
   "Film type integrated circuits", including silicon-on-sapphire integrated circuits;
   "Optical integrated circuits".

1031. 1. a. 1. Integrated circuits, designed or rated as radiation hardened to withstand a total dose of 5 X 10^5 rad (Si), or higher; (For integrated ircuits designed or rated against neutron or transient ionizing radiation, see the Munitions List.)

1031. 1. a. 2. Integrated circuits described in 1031.1.a.3 to 10, rated for operation at an ambient temperature below 219 K (-54" C) or above 398 K (125" C);

NOTE:

1031.1.a.2. does not apply to integrated circuits for civil automobiles or railway engines.

1031. 1. a. 3. "Microprocessor microcircuits", "microcomputer microcircuits" and microcontroller microcircuits, having any of the following:

NOTES:

1. 1031.1.a.3. does not embargo silicon-based "microcomputer microcircuits" or microcontroller microcircuits having an operand (data) word length of 8 bit or less and not covered by Note 2 to 1031.

2. 1031.1.a.3. includes digital signal processors, digital array processors and digital coprocessors.

1031. 1. a. 3. a. An external data bus width exceeding 32 bit or an arithmetic logic unit with an access width exceeding 32 bit;

b. A clock frequency exceeding 40 MHz;

c. An external data bus width of 32 bit or more and capable of executing 12.5 million instructions per second (MIPS) or more; or

Technical Note:

If MIPS are not specified, the inverse of the average instruction cycle time (in microseconds) should be used.

d. More than one data or instruction bus or serial communication port for external interconnection in a parallel processor with a transfer rate exceeding 2.4 Mbyte/s;

1031. 1. a. 4. Storage integrated circuits, as follows:

a. Electrical erasable programmable read-only memories (EEPROMs) with a storage capacity:

1. Exceeding 1 Mbit per package; or
2. Exceeding 256 kbit per package and a maximum access time of less than 80 ns;

b. Static random-access memories (SRAMs) with a storage capacity:

1. Exceeding 1 Mbit per package; or
2. Exceeding 256 kbit per package and a maximum access time of less than 25 ns;

c. Storage integrated circuits manufactured from a compound semiconductor;

1031. 1. a. 5. Converter integrated circuits, as follows:

a. Analogue-to-digital converters having any of the following:

1. A resolution of 8 bit or more, but less than 12 bit, with a total conversion time to maximum resolution of less than 10 ns;
2. A resolution of 12 bit with a total conversion time to maximum resolution of less than 200 ns;or
3. A resolution of more than 12 bit with a total conversion time to maximum resolution of less than 2 microseconds;

b. Digital-to-analogue converters with a resolution of 12 bit or more, and a "settling time" of less than 10 ns;

1031. 1. a. 6. Electro-optical or "optical integrated circuits" for "signal processing" having all of the following:

a. One or more internal "laser" diodes;
b. One or more internal light detecting elements; and
c. Optical waveguides;

1031. 1. a. 7. Field programmable gate arrays having either of the following:

a. An equivalent gate count of more than 30,000 (2 input gates); or

b. A typical "basic gate propagation delay time" of less than 0.4 ns;

1031. 1. a. 8. Field programmable logic arrays having either of the following:

a. An equivalent gate count of more than 5,000 (2 input gates); or

b. A toggle frequency exceeding 100 MHz;

1031. 1. a. 9. Neural network integrated circuits;

1031. 1. a. 10. Custom integrated circuits for which either the function is unknown, or the embargo status of the equipment in which the integrated circuits will be used is unknown to the manufacturer, having any of the following:

a. More than 144 terminals;

b. A typical "basic gate propagation delay time" of less than 0.4 ns; or

c. An operating frequency exceeding 3 GHz;

1031. 1. a. 11. Digital integrated circuits, other than those described in 1031.1.a.3 to 10., based upon any compound semiconductor and having either of the following:

a. An equivalent gate count of more than 300 (2 input gates); or

b. A toggle frequency exceeding 1.2 GHz;

1031. 1. b. Microwave or millimetre wave devices:

1. Electronic vacuum tubes and cathodes, as follows: (For "frequency agile" tubes, see Item 2011 on the Munitions List.)

NOTE:
1031.1.b.1.does not embargo tubes designed or rated to operate in the Standard Civil Telecommunications Bands at frequencies not exceeding 31 GHz.

a. Travelling wave tubes, pulsed or continuous wave, as follows:
   1. Operating at frequencies higher than 31 GHz;
   2. Having a cathode heater element with a turn on time to rated RF power of less than 3 seconds;
   3. Coupled cavity tubes, or derivatives thereof;
   4. Helix tubes, or derivatives thereof, with any of the following:
      a. 1. An "instantaneous bandwidth" of half an octave or more; and
         2. The product of the rated average ouput power (expressed in kW) and the maximum operating frequency (expressed in GHz) of more than 0.2;
      b. 1. An "instantaneous bandwidth" of less than half an octave; and
         2. The product of the rated average ouput power (expressed in kW) and the maximum operating frequency (expressed in GHz) of more than 0.4; or
      c. "Space qualified";

b. Crossed-field amplifier tubes with a gain of more than 17 dB;

c. Impregnated cathodes for electronic tubes, with either of the following:
   1. Having a turn on time to rated emission of less than 3 seconds; or
   2. Producing a continuous emission current density at rated operating conditions exceeding 5 A/cm^2;

1031.1.b. 2. Microwave integrated circuits or modules containing "monolithic integrated circuits" operating at frequencies exceeding 3 GHz;

> NOTE: 1031.1.b.2. does not embargo circuits or modules for equipment designed or rated to operate in the Standard Civil Telecommunications Bands at frequencies not exceeding 31 GHz.

1031.1.b. 3. Microwave transistors rated for operation at frequencies exceeding 31 GHz;

1031.1.b. 4. Microwave solid state amplifiers, as follows:

a. Operating at frequencies exceeding 10.5 GHz and having an "instantaneous bandwidth" of more than half an octave;

b. Operating at frequencies exceeding 31 GHz;

NOTE: 1031.1.b.4. does not embargo amplifiers:

1. Specially designed for medical applications;

2. Specially designed for use in "simple educational devices"; or

3. Having an output power of no more than 10 W and specially designed for:

    a. Industrial or civilian intrusion, detection and alarm systems;

    b. Traffic or industrial movement control and counting systems; or

    c. Systems for the detection of environmental pollution of air or water.

1031.1.b. 5. Electronically or magnetically tunable band-pass or band-stop filters having more than 5 tunable resonators capable of tuning across a 1.5:1 frequency band (f_{max}/f_{min}) in less than 10 microseconds with:

a. A band-pass bandwidth of more than 0.5% of centre frequency; or

b. A band-stop bandwidth of less than 0.5% of centre frequency;

1031.1.b. 6. Microwave assemblies capable of operating at frequencies exceeding 31 GHz;

1031.1.b. 7. Flexible waveguides designed for use at frequencies exceeding 40 GHz;

1031. 1. c. Acoustic wave devices, as follows, and specially designed components therefor:

1031.1.c. 1. Surface acoustic wave and surface skimming (shallow bulk) acoustic wave devices (i.e., "signal processing" devices employing elastic waves in materials), having either of the following:

NOTE: 1031.1.c.1. does not embargo devices specially designed for home electronics or entertainment.

a. A carrier frequency exceeding 1 GHz; or

b. A carrier frequency of 1 GHz or less, and:

1. A frequency side-lobe rejection exceeding 55 dB;

2. A product of the maximum delay time and the bandwidth (time in microseconds and bandwidth in MHz) of more than 100; or

3. A dispersive delay of more than 10 microseconds;

1031.1.c. 2. Bulk (volume) acoustic wave devices (i.e., "signal processing" devices employing elastic waves) which permit direct processing of signals at frequencies exceeding 1 GHz;

1031.1.c. 3. Acoustic-optic "signal processing" devices employing interaction between acoustic waves (bulk wave or surface wave) and light waves which permit the direct processing of signals or images, including spectral analysis, correlation or convolution;

NOTE:
1031.1.c.3. does not embargo devices specially designed for civil television, video or AM and FM broadcasting equipment.

1031. 1. d. Electronic devices or circuits containing components, manufactured from "superconductive" materials specially designed for operation at temperatures below the "critical temperature" of at least one of the "superconductive" constituents, with any of the following:

1. Electromagnetic amplification:

    a. At frequencies equal to or less than 31 GHz with a noise figure of less than 0.5 dB; or

    b. At frequencies exceeding 31 GHz;

2. Current switching for digital circuits using "superconductive" gates with a product of delay time per gate (in seconds) and power dissipation per gate (in watts) of less than 10^{-14} J; or

3. Frequency selection at all frequencies using resonant circuits with Q-values exceeding 10,000;

1031. 1. e. High energy devices, as follows:

1. Batteries, as follows:

    NOTE:
    1031.1.e.1. does not embargo batteries with volumes equal to or less than 26 cm^3 (e.g., standard C-cells or UM-2 batteries).

    a. Primary cells and batteries having an energy density exceeding 350 Wh/kg and rated for operation in the temperature range from below 243 K (-30° C) to above 343 K (70° C);

    b. Rechargeable cells and batteries having an energy density exceeding 150 Wh/kg after 75 charge/discharge cycles at a discharge current equal to C/5 hours (C being the nominal capacity in ampere hours) when operating in the temperature range from below 253 K (-20° C) to above 333 K (60° C);

Technical Note:
Energy density is obtained by multiplying the average power in watts (average voltage in volts times average current in amperes) by the duration of the discharge in hours to 75% of the open circuit voltage divided by the total mass of the cell (or battery) in kg.

    c. "Space qualified" and radiation hardened photovoltaic arrays with a specific power exceeding 160 W/m^2 at an operating temperature of 301 K (28° C) under a tungsten illumination of 1 kW/m^2 at 2,800 K (2,527° C);

1031.1.e. 2. High energy storage capacitors, as follows:

a. Capacitors with a repetition rate of less than 10 Hz (single shot capacitors) having all of the following:

1. A voltage rating equal to or more than 5 kV;

2. An energy density equal to or more than 250 J/kg; and

3. A total energy equal to or more than 25 kJ;

b. Capacitors with a repetition rate of 10 Hz or more (repetition rated capacitors) having all of the following:

1. A voltage rating equal to or more than 5 kV;

2. An energy density equal to or more than 50 J/kg;

3. A total energy equal to or more than 100 J; and

4. A charge/discharge cycle life equal to or more than 10,000;

1031.1.e. 3. "Superconductive" electromagnets or solenoids specially designed to be fully charged or discharged in less than one minute, having all of the following:

NOTE:
1031.1.e.3. does not embargo "superconductive" electromagnets or solenoids specially designed for Magnetic Resonance Imaging (MRI) medical equipment.

a. Maximum energy delivered during the discharge divided by the duration of the discharge of more than 500 kJ per minute;

b. Inner diameter of the current carrying windings of more than 250 mm; and

c. Rated for a magnetic induction of more than 8 T or "overall current density" in the winding of more than 300 A/mm^2;

1031.1.e. 4. Circuits or systems for electromagnetic energy storage, containing components manufactured from "superconductive" materials specially designed for operation at temperatures below the "critical temperature" of at least one of their "superconductive" constituents, having all of the following:

a. Resonant operating frequencies exceeding 1 MHz;

b. A stored energy density of 1 MJ/m^3 or more; and

c. A discharge time of less than 1 ms;

1031.1.e. 5. Flash discharge type X-ray systems, including tubes, having all of the following:

a. A peak power exceeding 500 MW;
b. An output voltage exceeding 500 kV; and
c. A pulse width of less than 0.2 microsecond;

1031. 1. f. Rotary input type shaft absolute position encoders having either of the following:

1. A resolution of better than 1 part in 265,000 (18 bit resolution) of full scale; or

2. An accuracy better than ±2.5 seconds of arc;

1031. 2. General purpose electronic equipment:

a. Recording equipment, as follows, and specially designed test tape therefor:

1. Analogue instrumentation magnetic tape recorders, including those permitting the recording of digital signals (e.g., using a high density digital recording (HDDR) module), having any of the following:
a. A bandwidth exceeding 4 MHz per electronic channel or track;

b. A bandwidth exceeding 2 MHz per electronic channel or track and having more than 42 tracks; or

c. A time displacement (base) error, measured in accordance with applicable IRIG or EIA documents, of less than ±0.1 microsecond;

2. Digital video magnetic tape recorders having a maximum digital interface transfer rate exceeding 180 Mbit/s, except those specially designed for television recording as standardized or recommended by the CCIR or the IEC for civil television applications;

3. Digital instrumentation magnetic tape data recorders having any of the following characteristics:

   a. A maximum digital interface transfer rate exceeding 60 Mbit/s and employing helical scan techniques;

   b. A maximum digital interface transfer rate exceeding 120 Mbit/s and employing fixed head techniques; or

   c. "Space qualified";

   NOTE:
   1031.2.a.3 does not embargo analogue magnetic tape recorders equipped with HDDR conversion electronics and configured to record only digital data.

4. Equipment, with a maximum digital interface transfer rate exceeding 60 Mbit/s, designed to convert digital video magnetic tape recorders for use as digital instrumentation data recorders;

1031.2. b. "Frequency synthesiser" "assemblies" having a "frequency switching time" from one selected frequency to another of less than 1 ms;

1031.2. c. "Signal analysers", as follows:

1. Capable of analysing frequencies exceeding 31 GHz;
2. "Dynamic signal analysers" with a "real-time bandwidth" exceeding 25.6 kHz, except those using only constant percentage bandwidth filters (also known as octave or fractional octave filters);

1031.2. d. Frequency synthesized signal generators producing output frequencies, the accuracy and short-term and long-term stability of which are controlled, derived from or disciplined by the internal master frequency, and having any of the following:

1. A maximum synthesised frequency exceeding 31 GHz;

2. A "frequency switching time" from one selected frequency to another of less than 1 ms; or

3. A single sideband (SSB) phase noise better than $(126 + 20 \log_{10}F - 20 \log_{10}f)$ in dBc/Hz, where F is the off-set from the operating frequency in Hz and f is the operating frequency in MHz;

NOTE:
1031.2.d. does not embargo equipment in which the output frequency is either produced by the addition or subtraction of two or more crystal oscillator frequencies, or by an addition or subtraction followed by a multiplication of the result.

1031.2. e. Network analysers with a maximum operating frequency exceeding 31 GHz;

NOTE:
1031.2.e. does not embargo "swept frequency network analysers" with a maximum operating frequency not exceeding 40 GHz and which do not contain a data bus for remote control interfacing.

1031.2. f. Microwave test receivers with both of the following:

1. A maximum operating frequency exceeding 31 GHz; and

2. Capable of measuring amplitude and phase simultaneously;

1031.2. g. Atomic frequency standards having either of the following characteristics:

1. Long term stability (aging) less (better) than 1×10^{-11}/month; or

2. "Space qualified";

NOTE:
1031.2.g.1. does not embargo non-"space qualified" rubidium standards.

1031.2. h. Emulators for microcircuits embargoed by 1031.1.a.3. or 1031.1.a.9.;

NOTE:
1031.2.h. does not embargo emulators designed for a "family" which contains at least one device not embargoed by 1031.1.a.3. or 1031.1.a.9.

1032. Test, Inspection and Production Equipment

1032. Equipment for the manufacture or testing of semiconductor devices or materials, as follows, and specially designed components and accessories therefor:

1. "Stored programme controlled" equipment for epitaxial growth, as follows:

   a. Capable of producing a layer thickness uniform to less than ±2.5% across a distance of 75 mm or more;

   b. Metal organic chemical vapour deposition (MOCVD) reactors specially designed for compound semiconductor crystal growth by the chemical reaction between materials embargoed by 1033.3 or 1033.4;

   c. Molecular beam epitaxial growth equipment using gas sources;

1032.2. "Stored programme controlled" equipment designed for ion implantation, having any of the following:

   a. An accelerating voltage exceeding 200 keV;

   b. Specially designed and optimized to operate at an accelerating voltage of less than 10 keV;

   c. Direct write capability; or

   d. Capable of high energy oxygen implant into a heated semiconductor material "substrate";

1032.3. "Stored programme controlled" anisotropic plasma dry etching equipment, as follows:

   a. With cassette-to-cassette operation and load-locks, and having either of the following:

      1. Magnetic confinement; or
      2. Electron cyclotron resonance (ECR);

   b. Specially designed for equipment embargoed by 1032.6. and having either of the following:

1. Magnetic confinement; or
2. Electron cyclotron resonance (ECR);

1032.4. "Stored programme controlled" plasma enhanced CVD equipment, as follows:

a. With cassette-to-cassette operation and load-locks, and having either of the following:

   1. Magnetic confinement; or
   2. Electron cyclotron resonance (ECR);

b. Specially designed for equipment embargoed by 1032.6. and having either of the following:

   1. Magnetic confinement; or
   2. Electron cyclotron resonance (ECR);

1032.5. "Stored programme controlled" multifunctional focussed ion beam systems specially designed for manufacturing, repairing, physical layout analysis and testing of masks or semiconductor devices, having either of the following:

a. Target-to-beam position feedback control precision of 0.25 micrometre or finer; or

b. Digital-to-analogue conversion resolution exceeding 12 bit;

1032.6. "Stored programme controlled" automatic loading multi-chamber central wafer handling systems, having interfaces for wafer input and output, to which more than two pieces of semiconductor processing equipment are to be connected, to form an integrated system in a vacuum environment for sequential multiple wafer processing;

NOTE:
1032.6. does not embargo automatic robotic wafer handling systems not designed to operate in a vacuum environment.

1032.7. "Stored programme controlled" lithography equipment, as follows:

a. Align and expose step and repeat equipment for wafer processing using photo-optical or X-ray methods, having any of the following:

   1. A light source wavelength shorter than 400 nm;

   2. A numerical aperture more than 0.40; or

3. An overlay accuracy of ±0.20 micrometre (3 sigma) or better;

   NOTE:
   1032.7.a. does not embargo align and expose step and repeat equipment having all of the following:

   1. A light source wavelength of 436 nm or more;
   2. A numerical aperture 0.38 or less; and
   3. An image size diameter 22 mm or less.

1032.7. b. Equipment specially designed for mask making or semiconductor device processing using deflected focussed electron beam, ion beam or "laser" beam, with any of the following:

1. A spot size smaller than 0.2 micrometre;
2. Capable of producing a pattern with a feature size of less than 1 micrometre; or an overlay accuracy of better than ± 0.20 micrometre (3 sigma);

1032.8. Masks or reticles, as follows:

a. For integrated circuits embargoed by 1031.1;
b. Multi-layer masks with a phase shift layer;

1032.9. "Stored programme controlled" test equipment, specially designed for testing semiconductor devices and unencapsulated dice, as follows:

a. For testing S-parameters of transistor devices at frequencies exceeding 31 GHz;
b. For testing integrated circuits, and "assemblies" thereof, and capable of performing functional (truth table) testing at a pattern rate of more than 40 MHz;
c. For testing microwave integrated circuits at frequencies exceeding 3 GHz;

NOTE:
1032.9.c. does not embargo test equipment specially designed for testing microwave integrated circuits for equipment designed or rated to operate in the Standard Civil Telecommunication Bands at frequencies not exceeding 31 GHz.

d. Electron beam systems designed for operation at or below 3 keV, or "laser" beam systems, for the non-contactive probing of powered-up semiconductor devices, with both of the following:

1. Stroboscopic capability with either beam-blanking or detector strobing; and

2. An electron spectrometer for voltage measurement with a resolution of less than 0.5 V;

NOTE:
1032.9.d. does not embargo scanning electron microscopes, except when specially designed and instrumented for the non-contactive probing of powered-up semiconductor devices.

1033. Materials

1033. 1. Hetero-epitaxial materials consisting of a "substrate" with stacked epitaxially grown multiple layers of:

a. Silicon;

b. Germanium; or

c. III/V compounds of gallium or indium;

Technical Note: III/V compounds are polycrystalline or binary or complex monocrystalline products consisting of elements of groups IIIA and VA of Mendeleyev's periodic classification table (gallium arsenide, gallium-aluminium arsenide, indium phosphide, etc.).

1033.2. Resist materials, as follows, and "substrates" coated with embargoed resists:

a. Positive resists with a spectral response optimized for use below 370 nm;

b. All resists, for use with electron beams or ion beams, with a sensitivity of 0.01 microcoulomb/mm^2 or better;

c. All resists, for use with X-rays, with a sensitivity of 2.5 mJ/mm² or better;

d. All resists optimized for surface imaging technologies, including silyated resists;

Technical Note: Silyation techniques are defined as processes incorporating oxidation of the resist surface to enhance performance for both wet and dry developing.

1033.3. Metal-organic compounds of aluminium, gallium or indium, having a purity (metal basis) better than 99.999%;

1033.4. Hydrides of phosphorus, arsenic or antimony, having a purity better than 99.999%, even diluted in neutral gases;

NOTE:
1033.4. does not embargo hydrides containing 20% molar or more of rare gases or hydrogen.

1034. Software

1034. 1. "Software" specially designed for the "development" or "production" of equipment embargoed by 1031.1.b. to 1031.2.h. or 1032.;

2. "Software" specially designed for the "use" of "stored programme controlled" equipment embargoed by 1032.;

3. Computer-aided-design (CAD) "software" for semiconductor devices or integrated circuits, having any of the following:

a. Design rules or circuit verification rules;
b. Simulation of the physically laid out circuits; or
c. Lithographic processing simulators for design;

Technical Note:
A lithographic processing simulator is a "software" package used in the design phase to define the sequence of lithographic, etching and deposition steps for translating masking patterns into specific topographical patterns in conductors, dielectrics or semiconductor material.

NOTE:
1034.3. does not embargo "software" specially designed for schematic entry, logic simulation, placing and routing, layout verification or pattern generation tape;

N.B.: Libraries, design attributes or associated data for the design of semiconductor devices or integrated circuits are considered as technology.

1035. Technology

1035. 1. Technology according to the General Technology Note for the "development" or "production" of equipment or materials embargoed by 1031., 1032. or 1033.;

NOTE:
1035.1. does not embargo technology for the "development" or "production" of:

a. Microwave transistors operating at frequencies below 31 GHz;

b. Integrated circuits embargoed by 1031.1.a.3. to 11., having both of the following characteristics:

1. Using technology of one micrometre or more, and

2. Not incorporating multi-layer structures.

N.B.: This Note does not preclude the export of multilayer technology for devices incorporating a maximum of two metal layers and two polysilicon layers.

1035.2. Other technology for the "development" or "production" of:

a. Vacuum microelectronic devices;

b. Hetero-structure semiconductor devices such as high electron mobility transistors (HEMT), hetero-bipolar transistors (HBT), quantum well or super lattice devices;

c. "Superconductive" electronic devices;

1040. COMPUTERS

NOTES:
1. Computers, related equipment or "software" performing telecommunications or "local area network" functions must also be evaluated against the performance characteristics of Category 1050 (Telecommunications).

2. Computers, related equipment or "software" performing cryptographic, cryptanalytic, certifiable multi-level security or certifiable user isolation functions, or which limit electromagnetic compatibility (EMC), must also be evaluated against the performance characteristics in Category 1150 ("Information Security").

N.B.:

1. Control units which directly interconnect the buses or channels of central processing units, "main storage" or disk controllers are not regarded as telecommunications equipment described in Category 1050 (Telecommunications).

2. For the embargo status of "software" which provides routing or switching of "datagram" or "fast select" packets (i.e., packet by packet route selection) or of "software" specially designed for packet switching, see Category 1050 (Telecommunications).

1041. Equipment, Assemblies and Components

1041. 1. Electronic computers and related equipment, as follows, and "assemblies" and specially designed components therefor:

a. Specially designed to have either of the following characteristics:

1. Rated for operation at an ambient temperature below 228 K (-45° C) or above 343 K (70° C); or

NOTE:
1041.1.a.1. does not apply to computers specially designed for civil automobile or railway engine applications.

2. Radiation-hardened to exceed any of the following specifications:

a. Total Dose 5×10^5 Rads (Si)

b. Dose Rate Upset 5×10^8 Rads (Si)/sec; or

c. Single Event Upset 1×10^{-7} Error/bit/day;

NOTE: Equipment designed or rated for transient ionising radiation is embargoed by the Munitions List.

b. Having characteristics or performing functions exceeding the limits in Category 1150 ("Information Security");

1041. 2. "Hybrid computers", as follows, and "assemblies" and specially designed components therefor:

a. Containing "digital computers" embargoed by 1041.3.;

b. Containing analogue-to-digital or digital-to-analogue converters having both of the following characteristics:

1. 32 channels or more; and

2. A resolution of 14 bits (plus sign bit) or more with a conversion rate of 200,000 conversions/s or more;

1041. 3. "Digital computers", "assemblies", and related equipment therefor, as follows, and specially designed components therefor:

NOTES:

1. 1041.3. includes vector processors, array processors, logic processors, and equipment for "image enhancement" or "signal processing".

2. The embargo status of the "digital computers" or related equipment described in 1041.3 is governed by the embargo status of other equipment or systems provided:

   a. The "digital computers" or related equipment are essential for the operation of the other equipment or systems;

   b. The "digital computers" or related equipment are not a "principal element" of the other equipment or systems; and

N.B.:
1. The embargo status of "signal processing" or "image enhancement" equipment described in 1041.3.g. and specially designed for other equipment with functions limited to those required for the other equipment is determined by the embargo status of the other equipment even if it exceeds the "principal element" criterion.

2. For the embargo status of "digital computers" or related equipment for telecommunications equipment, see Category 1050 (Telecommunications).

c. The technology for the "digital computers" and related equipment is governed by 1045.

3. "Digital computers" or related equipment are not embargoed by 1041.3 provided:

a. They are essential for medical applications;

b. The equipment is substantially restricted to medical applications by nature of its design and performance;

c. The equipment does not have "user-accessible programmability" other than that allowing for insertion of the original or modified "programmes" supplied by the original manufacturer;

d. The "composite theoretical performance" of any "digital computer" which is not designed or modified but essential for the medical application does not exceed 20 million theoretical operations per second (Mtops); and

e. The technology for the "digital computers" or related equipment is governed by 1045.

1041. 3. a. Designed for combined recognition, understanding and interpretation of image or continuous (connected) speech;

1041.3. b. Designed or modified for "fault tolerance";

NOTE:
For the purposes of 1041.3.b., "digital computers" and related equipment are not considered to be designed or modified for "fault tolerance", if they use:

1. Error detection or correction algorithms in "main storage";

2. The interconnection of two "digital computers" so that, if the active central processing unit fails, an idling but mirroring central processing unit can continue the system's functioning;

3. The interconnection of two central processing units by data channels or by use of shared storage to permit one central processing unit to perform other work until the second central processing unit fails, at which time the first central processing unit takes over in order to continue the system's functioning; or

4. The synchronisation of two central processing units by "software" so that one central processing unit recognises when the other central processing unit fails and recovers tasks from the failing unit.

1041.3. c. "Digital computers" having a "composite theoretical performance" (CTP) exceeding 12.5 million theoretical operations per second (Mtops);

1041.3. d. "Assemblies" specially designed or modified to enhance performance by aggregation of "computing elements", as follows:

NOTES:

1. 1041.3.d. applies only to "assemblies" and programmable interconnections not exceeding the limit in 1041.3.c., when shipped as un-integrated "assemblies". It does not apply to "assemblies" inherently limited by nature of their design for use as related equipment embargoed by 1041.3.e. to k.

2. 1041.3.d. does not embargo "assemblies" specially designed for a product or family of products whose maximum configuration does not exceed the limit of 1041.3.c.

1. Designed to be capable of aggregation in configurations of 16 or more "computing elements"; or

2. Having a sum of maximum data rates on all data channels available for connection to associated processors exceeding 40 MBytes/s;

1041.3. e. Disk drives and solid state storage equipment, as follows:

1. Magnetic, erasable optical or magneto-optical disk drives with a "maximum bit transfer rate" exceeding 25 Mbit/s;

2. Solid state storage equipment, other than "main storage" (also known as solid state disks or RAM disks), with a "maximum bit transfer rate" exceeding 36 Mbit/s;

1041.3. f. Input/output control units designed for use with equipment embargoed by 1041.3.e.;

1041.3. g. Equipment for "signal processing" or "image enhancement" having a "composite theoretical performance" exceeding 8.5 million theoretical operations per second (Mtops);

1041.3. h. Graphics accelerators or graphics coprocessors exceeding a "3-D Vector Rate" of 400,000 or, if supported by 2-D vectors only, a "2-D vector rate" of 600,000;

NOTE:

1041.3.h. does not apply to work stations designed for and limited to:

1. Graphic arts (e.g., printing, publishing); and

2. The display of two-dimensional vectors.

1041.3. i. Colour displays or monitors having more than 12 resolvable elements per mm in the direction of the maximum pixel density;

NOTES:

1. 1041.3.i. does not embargo displays or monitors not specially designed for electronic computers.

2. Displays specially designed for Air Traffic Control (ATC) systems are treated as specially designed components for ATC systems under Category 1060.

1041.3. j. Equipment performing analogue-to-digital or digital-to-analogue conversions exceeding the limits in 1031.1.a.5.;

1041.3. k. Equipment containing "terminal interface equipment" exceeding the limits in 1051.b.3.;

NOTE:

For the purposes of 1041.3.k., "terminal interface equipment" includes "local area network" interfaces, modems and other communications interfaces. "Local area network" interfaces are evaluated as "network access controllers".

1041. 4. Computers, as follows, and specially designed related equipment, "assemblies" and components therefor:

a. "Systolic array computers";

b. "Neural computers";

c. "Optical computers";

1042. Test, Inspection and Production Equipment

1042. Equipment for the development and production of magnetic and optical storage equipment, as follows:

1. Equipment specially designed for the application of magnetic coating to embargoed non-flexible (rigid) magnetic or magneto-optical media;

   NOTE:

   1042.1.does not embargo general purpose "sputtering" equipment.

2. "Stored programme controlled" equipment specially designed for monitoring, grading, exercising or testing embargoed rigid magnetic media;

3. Equipment specially designed for the production or alignment of heads or head/disk assemblies for embargoed rigid magnetic and magneto-optical storage, and electromechanical or optical components therefor;

1043. Materials

Materials specially formulated for and required for the fabrication of head/disk assemblies for embargoed magnetic and magneto-optical hard disk drives;

1044. Software

NOTE:
The embargo status of "software" for the "development", "production", or "use" of equipment described in other Categories is dealt with in the appropriate Category. The embargo status of "software" for equipment described in this Category is dealt with herein.

1044. 1. "Software" specially designed or modified for the "development", "production" or "use" of equipment, materials or "software" embargoed by 1041.,1042., 1043. or 1044.;

1044. 2. "Software" specially designed or modified to support "technology" embargoed by 1045.

1044. 3. Specific "software", as follows:

a. "Programme" proof and validation "software" using mathematical and analytical techniques and designed or modified for "programmes" having more than 500,000 "source code" instructions;

b. "Software" allowing the automatic generation of "source codes" from data acquired on line from external sensors described in these Lists;

c. Operating system "software", "software" development tools and compilers specially designed for "multi-data-stream processing" equipment, in "source code";

d. "Expert systems" or "software" for "expert system" inference engines providing both:

1. Time dependent rules; and

2. Primitives to handle the time characteristics of the rules and the facts;

e. "Software" having characteristics or performing functions exceeding the limits in Category 1150 ("Information Security");

f. Operating systems specially designed for "real time processing" equipment which guarantees a "global interrupt latency time" of less than 30 microseconds;

1045. Technology

1045. 1. "Technology" according to the General Technology Note, for the "development", "production" or "use" of equipment, materials or "software" embargoed by 1041., 1042.,1043 or 1044.

1045. 2. a. "Technology" for the "development" or "production" of equipment released under 1041.3.h.;

b. "Technology" for the "development" or "production" of equipment designed for "multi-data-stream processing";

c. Technology "required" for the "development" or "production" of magnetic hard disk drives with a "maximum bit transfer rate" exceeding 11 Mbit/s.

NOTES:

1. Governments may permit, as administrative exceptions, the shipment of "digital computers" embargoed by 1041.3.c.,or specially designed components therefor, and "software" embargoed by 1044.1., provided:

a. They will be operated by civil end-users for civil applications;

b. They have been primarily designed and used for non-strategic applications;

c. The "CTP" of the "digital computers" does not exceed 20 Mtops;

d. They do not contain any embargoed related equipment;

e. When exported as enhancements, the enhanced "digital computer" does not exceed the limit in Note 1.c.;

f. They are not shipped as enhancements to computers designed within a proscribed country;

N.B.:
This does not preclude the enhancement of such computers when they are used by civil end-users in civil applications.

g. Any embargoed "software" is the minimum required for the "use" of the approved "digital computers";

h. The Government of the exporting country shall:

1. Be reasonably satisfied that:

        a. The equipment will be used primarily for the specific non-strategic application for which the export would be approved; and

        b. The equipment will not be used for the design, development or production of embargoed products;

    2. Promptly report monthly the export to the Committee, in the regular monthly statistical returns, identifying specifically the equipment to be provided, the end-user with his full name and address and the end-use of the equipment; and

    3. Promptly report to the Committee any evidence of the removal or diversion of the equipment from authorised purposes related to the specific export licence.

2. Governments may permit, as administrative exceptions, the shipment of equipment embargoed by 1041.3.e. or f. provided:

    a. The "maximum bit transfer rate" does not exceed 36 Mbit/s;

    b. They are exported as part of a computer system or as an enhancement to a previously exported system;

    c. The Government of the exporting country shall notify the Committee 30 days prior to the proposed export; and

    d. The Government of the exporting country shall:

        1. Be reasonably satisfied that:

            a. The equipment will be used primarily for the specific non-strategic application for which the export would be approved; and
            b. The equipment will not be used for the design, development or production of embargoed products;

        2. Promptly report monthly the export to the Committee, in the monthly statistical returns, identifying specifically the equipment to be provided, the end-user with his full name and address and the end-use of the equipment; and

        3. Promptly report to the Committee any evidence of the removal or diversion of the equipment from authorised purposes related to the specific export licence.

3. The Committee will favourably consider the export of "digital computers" or related equipment therefor embargoed by 1041.3.c., e., f. or g., or "software" embargoed by 1044.1., provided:

   a. They will be operated by civil end-users for civil applications;

   b. They have been primarily designed and used for non-strategic applications;

   c. They do not exceed any of the following limits:

      1. CTP of the "digital computers" - 23 Mtops;

      2. "Maximum bit transfer rate" of disk drives or input/output control units embargoed by 1041.3.e. or f. - 36 Mbit/s; or

      3. CTP of "signal processing" or "image enhancement" equipment - 12.5 Mtops;

   d. They do not contain any other embargoed related equipment;

   e. When exported as enhancements, the enhanced "digital computer" does not exceed the limit in Note 3.c.;

   f. They are not shipped as enhancements to computers designed within a proscribed area;

   g. Any embargoed "software" is the minimum required for the "use" of the approved "digital computers" and related equipment;

   h. Governments administer this Note as follows:

      1. The requesting Government will in all cases provide the Committee with information which includes:

         a. A signed statement by a responsible representative of the end-user(s) or the importing agency describing the end-use and certifying that:

            1. The "digital computers" or related equipment will:

               a. Be used only for civil applications; and

            b. Not be reexported or otherwise disposed of without permission from the Government of the exporting country;

        2. Responsible Western representatives of the supplier will:

            a. Have the right of access to the "computer using facility" and all equipment, wherever located, during normal working hours and at any other time the equipment is operating; and

            b. Be furnished information demonstrating continued authorised application of the equipment; and

            c. These Western representatives will be notified of any significant change of application or of other facts, on which the licence was based;

    b. A full description of:

        1. The equipment; and

        2. Its intended application and workload; and

    c. A complete identification of all end-users and their activities;

2. The requesting Government will in all cases:

    a. Promptly report to the Committee evidence of:

        1. Any violation of the conditions of this Note; or

        2. Any removal or diversion of the equipment from authorised purposes, related to the specific export licence; and

    b. In such cases, immediately terminate to the extent possible and in accordance with their legislation, all further shipments of equipment and spare parts, technology and "software" therefor by the supplier to the specified end-user(s);

i. The Committee will:

1. Approve the export of equipment described in this Note if no member country has filed an objection within four weeks of the receipt of complete information on the case; and

2. Consider, when assessing proposed exports and the comments of member countries on such proposed exports:
    a. The appropriateness of the equipment to the stated end-use;

    b. Any evidence which would indicate that the proposed end-users are:

        1. Directly involved in significant strategic, including intelligence, activities; or

        2. Affiliated with organisations that foster diversion to strategic purposes;

    c. The extent to which the equipment will support the strategic activities of the end-users; and

    d. The extent to which diversion would disrupt the activities of the proposed end-users

1040. Technical Note:

"COMPOSITE THEORETICAL PERFORMANCE" (CTP)

Abbreviations used in this Technical Note

CE	"computing element" (typically an arithmetic logical unit)
FP	floating point
XP	fixed point
t	execution time
XOR	exclusive OR
CPU	central processing unit
TP	theoretical performance (of a single CE)
CTP	"composite theoretical performance" (multiple CEs)
R	effective calculating rate Execution time 't' is expressed in microseconds, and CTP is expressed in Mtops (millions of theoretical operations per second).

CTP is a measure of computational performance given in millions of theoretical operations per second (Mtops). In calculating the "Composite Theoretical Performance" (CTP) of a configuration of Computing Elements (CEs) the following three steps are required:

1. Calculate the effective calculating rate R for each CE;
2. Apply the word length adjustment to this rate, resulting in a Theoretical Performance (TP) for each CE. Select the maximum resulting value of TP;

3. If there is more than one "computing element", combine the TPs resulting in a "Composite Theoretical Performance" for the configuration.

   NOTE:
   This aggregation should not be applied to computers connected through a decontrolled "local area network".

4. Technical Note:
   "COMPOSITE THEORETICAL PERFORMANCE" (CTP) The following table shows the method of calculating the Effective Calculating Rate R for each Computing Element:

For Computing Element's (CE'S) Implementing:	Effective calculating Rate, R
XP only (Rxp)	$\frac{1}{(3 \times t_{xp\ add})}$ if no add is implemented use: $\frac{1}{(3 \times t_{xp\ add})}$ If neither add nor multiply is implemented use the fastest available arithmetic operation as follows: $\frac{1}{(3 \times t_{xp\ add})}$ See Notes X & Z
FP only	$\max \frac{1}{t_{fp\ add}}, \frac{1}{t_{fp\ mult}}$ See notes X & Z
Both FP and XP	Calculate both Rxp, Rfp
For simple logic processors not implementing any of the specified arithmetic operations.	$\frac{1}{3 \times t_{log}}$ Where tlog is the execution time of the XOR, or for logic hardware not implementing the XOR, the fastest simple logic operation. See Notes X & Z

For special logic processors not using any of the specified arithmetic or logic operations.	$R = R' * WL/64$ where R' is the number of results per second, WL is the number of bits upon which the logic operation occurs, and 64 is a factor to normalize to a 64 bit operation.

1040. Technical Note:

"COMPOSITE THEORETICAL PERFORMANCE" (CTP) (con't)

Note X: For CEs which perform multiple arithmetic operations of a specific type in a single cycle (e.g., two additions per cycle), the execution time t is given by:

$$t = \frac{\text{cycle time}}{\text{the number of arithmetic operations per machine cycle}}$$

CEs which perform different types of arithmetic operations in a single machine cycle are to be treated as multiple separate CEs performing simultaneously (e.g., a CE performing an addition and a multiplication in one cycle is to be treated as two CEs, the first performing an addition in one cycle and the second performing a multiplication in one cycle). If a single CE has both scalar function and vector function, use larger value.

Note Y: If no FP add or FP multiply are implemented, but the CE performs FP divide:

$$R_{fp} = \frac{1}{t_{fp\ divide}}$$

If the divide is not implemented, the fp reciprocal should be used. If none of the specified instructions is implemented, the effective FP rate is 0.

Note Z: In simple logic operations, a single instruction performs a single logic manipulation of no more than two operands of given lengths. In complex logic operations, a single instruction performs multiple logic manipulations to produce one or more results from two or more operands. Rates should be calculated for all supported operand lengths, using the fastest executing instruction for each operand length based on:

1. Register-to-register. Exclude extraordinarily short execution times generated for operations on a predetermined operand or operands (for example, multiplication by 0 or 1). If no register-register operations are implemented, continue with (2).

2. The faster of register-to-memory or memory-to-register operations; if these also do not exist, then continue with (3).

3. Memory-to-memory.

In each case above, use the shortest execution time certified by the manufacturer.

1050. TELECOMMUNICATIONS

NOTES:

A. The embargo status of components, "lasers", test and production equipment, materials and "software" therefor which are specially designed for telecommunications equipment or systems is defined in this Category.

B. "Digital computers", related equipment or "software", when essential for the operation and support of telecommunications equipment described in this Category, are regarded as specially designed components, provided they are the standard models customarily supplied by the manufacturer. This includes operation, administration, maintenance, engineering or billing computer systems.

1051. Equipment, Assemblies and Components

1051. a. Any type of telecommunications equipment having any of the following characteristics, functions or features:

1. Specially designed to withstand transitory electronic effects or electromagnetic pulse arising from a nuclear explosion;

2. Specially hardened to withstand gamma, neutron or ion radiation;

3. Specially designed to operate outside the temperature range from 219 K (-54° C) to 397 K (124° C);

   NOTE:
   1051.a.3. applies only to electronic equipment.

NOTE:
1051.a.2. and 3. do not apply to equipment on board satellites.

1051. b. "Telecommunication transmission equipment" or systems, and specially designed components and accessories therefor, having any of the following characteristics, functions or features:

NOTE:
"Telecommunication transmission equipment"

a. Categorised as follows, or combinations thereof:

1. Radio equipment (e.g., transmitters, receivers and transceivers);

2. Line terminating equipment;

3. Intermediate amplifier equipment;

4. Repeater equipment;

5. Regenerator equipment;

6. Translation encoders (transcoders);

7. Multiplex equipment (statistical mutiplex included);

8. Modulators/ demodulators (modems);

9. Transmultiplex equipment (see CCITT Rec. G701);

10. "Stored programme controlled" digital cross-connection equipment;

11. "Gateways" and bridges;

12. "Media access units; and

b. Designed for use in single or multi-channel communication via:

1. Wire (line);

2. Coaxial cable;

3. Optical fibre cable;

4. Electromagnetic radiation.

1051. b. 1. Employing digital techniques, including digital processing of analogue signals, and designed to operate at a "digital transfer rate" at the highest multiplex level exceeding 45 Mbit/s or a "total digital transfer rate" exceeding 90 Mbit/s;

NOTE:
1051.b.1. does not embargo equipment specially designed to be integrated and operated in any satellite system for civil use.

1051. b. 2. Being "stored programme controlled" digital cross connect equipment with a "digital transfer rate" exceeding 8.5 Mbit/s per port;

1051. b. 3. Being equipment containing:

a. Modems using the "bandwidth of one voice channel" with a "data signalling rate" exceeding 9,600 bit/s;

b. "Communication channel controllers" with a digital output having a "data signalling rate" exceeding 64,000 bit/s per channel; or

c. "Network access controllers" and related common medium having a "digital transfer rate" exceeding 33 Mbit/s;

NOTE:
If any unembargoed equipment contains "network access controller", it cannot have any type of telecommunications interface except those described in, but not embargoed by, 1051.b.3.

1051. b. 4. Employing a "laser" and having any of the following characteristics:

a. A transmission wavelength exceeding 1,000 nm;

b. Employing analogue techniques and having a bandwidth exceeding 45 MHz;

c. Employing coherent optical transmission or coherent optical detection techniques (also called optical heterodyne or homodyne techniques);

d. Employing wavelength division multiplexing techniques; or

e. Performing "optical amplification";

1051. b. 5. Being radio equipment operating at input or output frequencies exceeding:

a. 31 GHz for satellite-earth station applications;

b. 26.5 GHz for other applications;

NOTE:
1051.b.5.b.does not embargo equipment for civil use conforming with an ITU allocated band between 26.5 and 31 GHz.

1051. b. 6. Being radio equipment:

a. Employing quadrature-amplitude-modulation (QAM) techniques above level 4; or

b. Employing other digital modulation techniques and having a "spectral efficiency" exceeding 1 bit/sec/Hz;

NOTE:
1051.b.6.b. does not embargo equipment specially designed to be integrated and operated in any satellite system for civil use.

1051. b. 7. Being radio transmitting equipment operating in the 1.5 to 87.5 MHz band and having either of the following characteristics:

a. 1. Automatically predicting and selecting frequencies and "total digital transfer rates" per channel to optimize the transmission; and

2. Incorporating a linear power amplifier configuration having a capability to support multiple signals simultaneously at an output power of 1 kW or more in the 1.5 to 30 MHz frequency range or 250 W or more in the 30 to 87.5 MHz frequency range, over an "instantaneous bandwidth" of one octave or more and with an output harmonic and distortion content of better than -80 dB; or

b. Incorporating adaptive techniques providing more than 15 dB suppression of an interfering signal;

1051. b. 8. Being radio equipment employing "spread spectrum" or "frequency agility" (frequency hopping) techniques having either of the following characteristics:

  a. User programmable spreading codes; or

  b. A total transmitted bandwidth which is 100 or more times the bandwidth of any one information channel and in excess of 50 kHz;

1051. b. 9. Being digitally controlled radio receivers having more than 1,000 channels, which:

  a. Search or scan automatically a part of the electromagnetic spectrum;

  b. Identify the received signals or the type of transmitter; and

  c. Have a "frequency switching time" of less than 1 ms;

1051. b. 10. Providing functions of digital "signal processing" as follows:

  a. Voice coding at rates of less than 2,400 bit/s;

  b. Employing circuitry which incorporates "user-accessible programmability" of digital "signal processing" circuits exceeding the limits of 1041.3.g.;

1051. b. 11. Being underwater communications systems having any of the following characteristics:

  a. An acoustic carrier frequency outside the range from 20 to 60 kHz;

  b. Using an electromagnetic carrier frequency below 30 kHz; or

  c. Using electronic beam steering techniques;

1051. c. "Stored programme controlled" switching equipment and related signalling systems, having any of the following characteristics, functions or features; and specially designed components and accessories therefor:

NOTE:
Statistical multiplexers with digital input and digital output which provide switching are treated as "stored programme controlled" switches.

1051. c. 1. "Common channel signalling";

NOTE:
Signalling systems in which the signalling channel is carried in and refers to no more than 32 multiplexed channels forming a trunk line of no more than 2.1 Mbit/s, and in which the signalling information is carried in a fixed, time division multiplexed channel without the use of labelled messages, are not considered to be "common channel signalling" systems.

1051. c. 2. Containing "Integrated Services Digital Network" (ISDN) functions and having either of the following:

a. Switch-terminal (e.g., subscriber line) interfaces with a "digital transfer rate" at the highest multiplex level exceeding 192,000 bit/s, including the associated signalling channel (e.g., 2B+D); or

b. The capability that a signalling message received by a switch on a given channel that is related to a communication on another channel may be passed through to another switch;

NOTE:
1051.c.2. does not preclude:

1. The evaluation and appropriate actions taken by the receiving switch;

2. Unrelated user message traffic on a D channel of ISDN.

1051. c. 3. Multi-level priority and pre-emption for circuit switching;
NOTE:
1051.c.3. does not embargo single-level call pre-emption.

1051. c. 4. "Dynamic adaptive routing";

1051. c. 5. Routing or switching of "datagram" packets;

1051. c. 6. Routing or switching of "fast select" packets;

NOTE:
The restrictions in 1051.c.5. and 6. do not apply to networks using only "network access controllers" or to "network access controllers" themselves.

1051. c. 7. Designed for automatic hand-off of cellular radio calls to other cellular switches or for automatic connection to a centralized subscriber data base common to more than one switch;

1051. c. 8. Being packet switches, circuit switches and routers with ports or lines exceeding either:

a. A "data signalling rate" of 64,000 bit/s per channel for a "communications channel controller"; or

NOTE:
1051.c.8.a. does not preclude the multiplexing over a composite link of communications channels not embargoed by 1051.c.8.a.

b. A "digital transfer rate" of 33 Mbit/s for a "network access controller" and related common medium;

1051. c. 9. "Optical switching";

1051. c. 10. Employing "Asynchronous Transfer Mode" (ATM) techniques;

11. Containing "stored programme controlled" digital crossconnect equipment with a "digital transfer rate" exceeding 8.5 Mbit/s per port;

1051. d. Centralized network control having both of the following characteristics:

1. Receives data from the nodes; and

2. Processes these data in order to provide control of traffic not requiring operator decisions, thereby performing "dynamic adaptive routing";

NOTE:
1051.d. does not preclude control of traffic as a function of predictable statistical traffic conditions.

1051. e. Optical fibre communication cables, optical fibres and specially designed components and accessories therefor, as follows:

1. Optical fibres or cables of more than 50 m in length having either of the following characteristics:

a. Designed for single mode operation; or

b. For optical fibres, capable of withstanding a "proof test" tensile stress of 2×10^9 N/m2 or more;

Technical Note:
"Proof Test" On-line or off-line production screen testing that dynamically applies a prescribed tensile stress over a 0.5 to 3 m length of fibre at a running rate of 2 to 5 m/s while passing between capstans approximately 15 cm in diameter. The ambient temperature is a nominal 293 K and relative humidity 40%.

N.B.: Equivalent national standards may be used for executing the "proof test".

1051. e. 2. Components and accessories specially designed for the optical fibres or cables embargoed by 1051.e.1., except connectors for use with optical fibres or cables with a repeatable coupling loss of 0.5 dB or more;

1051. e. 3. Optical fibre cables and accessories designed for underwater use; (For fibre-optic hull penetrators or connectors, see 1081.2.c.)

1051. f. Phased array antennae, operating above 10.5 GHz, containing active elements and distributed components, and designed to permit electronic control of beam shaping and pointing, except those for landing systems with instruments meeting ICAO standards (microwave landing systems (MLS));

1052. Test, Inspection and Production Equipment

1052. a. Equipment specially designed for:

1. Development of equipment, materials, functions or features embargoed by 1051., 1052., 1053., 1054. or 1055., including measuring or test equipment;

2. Production of equipment, materials, functions or features embargoed by 1051., 1052., 1053., 1054. or 1055., including measuring, test or repair equipment;

3. Use of equipment, materials, functions or features exceeding any of the least stringent embargo criteria applicable in 1051., 1052., 1053., 1054. or 1055., including measuring, repair or test equipment;

052. b. Other equipment as follows:

1. Bit error rate (BER) test equipment designed or modified to test the equipment embargoed in 1051.b.1.;
2. Data communication protocol analyzers, testers and simulators for functions embargoed by 1051.b.1.;
3. Stand alone "stored programme controlled" radio transmission media simulators/channel estimators specially designed for testing equipment embargoed by 1051.b.5.

1053. Materials

Preforms of glass or of any other material optimized for the manufacture of optical fibres embargoed by 1051.e.;

1054. Software

1054. a. "Software" specially designed or modified for the development, production or use of equipment or materials embargoed by 1051., 1052 or 1053.;

b. "Software" specially designed or modified to support "technology" embargoed by 1055.;

c. Specific "software" as follows:

1. "Generic software", other than in machine-executable form, specially designed or modified for the "use" of "stored program controlled" digital switching equipment or systems;
2. "Software", other than in machine-executable form, specially designed or modified for the "use" of digital cellular radio equipment or systems;
3. "Software" specially designed or modified to provide characteristics, functions or features of equipment embargoed by 1051. or 1052.;
4. "Software" which provides capability of recovering "source code" of telecommunications "software" embargoed by this category;
5. "Software" specially designed for the "development" or "production" of "software" embargoed by 1054.; (For "software" for "signal processing" see also 1044. and 1064.)

1055. Technology

1055. a. Technology according to the General Technology Note for the "development", "production" or "use" (excluding operation) of equipment, systems, materials or "software" embargoed by 1051., 1052., 1053. or 1054.

b. Specific technologies as follows:

1. "Required" technology for the "development" or "production" of telecommunications equipment specially designed to be used on board satellites;

2. Technology for the "development" or "use" of laser communication techniques with the capability of automatically acquiring and tracking signals and maintaining communications through exoatmosphere or sub-surface (water) media;

3. Technology for processing and application of coatings to optical fiber specially designed to make it suitable for underwater use;

4. Technology for "development" or "production" of equipment employing "Synchronous Digital Hierarchy" (SDH) or "Synchronous Optical Network" (SONET) techniques;

5. Technology for the "development" or "production" of "switch fabric" exceeding 64,000 bits per second per information channel other than for digital cross connect integrated in the switch;

6. Technology for the "development" or "production" of centralized network control;

7. Technology for the "development" or "production" of digital cellular radio systems;

8. Technology for the "development" or "production" of "Integrated Services Digital Network" (ISDN).

NOTES:

1. Governments may permit, as administrative exceptions, the shipment of telecommunications equipment for optical fibres embargoed by 1051.b.4.a., provided the transmission wavelength does not exceed 1370 nm.

2. Governments may permit, as administrative exceptions, the shipment of cables or fibres embargoed by 1051.e. provided:

a. Quantities are normal for the envisaged end-use; and

b. They are for a specified civil end-use.

3. Governments may permit, as administrative exceptions, the shipment of optical fibre test equipment embargoed by 1052.a.3. using a transmission wavelength not exceeding 1370 nm.

4. Governments may permit, as administrative exceptions, the shipment to COCOM-agreed countries of equipment or systems embargoed by 1051.b., c., d., e. or f., and test equipment, "software" and "use" technology therefor, provided the Government of the exporting country:

   a. Is reasonably satisfied that the equipment or systems:

      1. Are designed for and will be used for specific civil applications; and

      2. Will be operated in the importing country by a civil end-user who has furnished to the supplier a signed statement certifying that the equipment or systems will be used only for the specific end-use;

   b. Notifies the Committee at the time of licensing the export under the provisions of this Note. The information to accompany each case will include:

      1. End-use assurances provided by the importer and backed by his national authorities;

      2. A full description of the equipment or systems to be provided;

      3. The installation site and intended application; and

   c. Promptly reports to the Committee evidence of:

      1. Any violation of the conditions of this Note; or

      2. Any removal or diversion of the equipment from authorized purposes related to the specific export licence.

5. Governments may permit, as administrative exceptions, the shipment of digital radio equipment or systems embargoed by 1051.b.1. or 1051.b.6. provided:

a. The equipment or system is intended for general commercial international traffic in an international civil telecommunication system, one end of which is in a COCOM member country;

b. It is to be installed in a permanent circuit under the supervision of the COCOM member country licensee;

c. No means are to be provided for the transmission of traffic between points in a single proscribed country other than a COCOM-agreed country;

d. The "digital transfer rate" at the highest multiplex level does not exceed 156 Mbit/s;

e. The equipment does not employ either of the following:

    1. Quadrature Amplitude Modulation (QAM) techniques above 64 QAM; or

    2. Other digital modulation techniques with a "spectral efficiency" exceeding 6 bit/s/Hz;

f. The equipment is not embargoed by 1051.b.5., 1051.b.8. or 1151.;

g. Spare parts shall remain under control of the COCOM member country licensee;

h. The COCOM member country licensee or his designated representative who shall be from a non-proscribed country shall have the right of access to all the equipment;

i. There will be no transfer of embargoed technology;

j. Systems installation, operation and maintenance shall be performed by the licensee or the licensee's designated representative, who shall be from a non-proscribed country, using only personnel from non-proscribed countries, until such time as the Committee agrees otherwise;

k. Upon request, the licensee shall carry out an inspection to establish that:

    1. The system is being used for the intended civil purpose; and

2. All the equipment exported under the provisions of this Note is being used for the stated end purpose and is still located at the installation sites;

After each inspection, the licensee shall report his findings to his authorities within one month. The Government of the exporting country must report any deviation from these conditions to the Committee;

1. Governments will notify the Committee 30 days in advance of issuing the licence.

6. Will be favourably considered the export of radio relay communications equipment, specially designed components and accessories, specially designed test equipment, "software" and technology for the "use" of equipment or materials therefor, embargoed by 1051., 1052., 1053., 1054. or 1055., provided:

   a. It is for fixed installation and civil application;

   b. It is designed for operation at a "digital transfer rate" not exceeding 156 Mbit/s;

   c. The equipment does not employ either of the following:

      1. Quadrature Amplitude Modulation (QAM) techniques above 64 QAM; or

      2. Other digital modulation techniques with a "spectral efficiency" exceeding 6.3 bit/s/Hz;

   d. It operates at fixed frequencies not exceeding 9 GHz;

   e. When submitting export requests under the provisions of this Note, the Government of the exporting country will provide a statement identifying:

      1. The equipment or system to be provided;

      2. The intended application; and

      3. The location of the equipment.

   f. The Committee will approve the case if no member country has raised an objection within four weeks of the receipt of complete information on the application.

7. Will be favourably considered the export of optical fibre cables and optical fibre transmission equipment or systems embargoed by 1051.b. or 1051.e., provided:

   a. The equipment or system is intended for general commercial international traffic in an international civil submarine optical fibre telecommunication system linking the importing country with a COCOM member country;

   b. It is to be installed in a permanent circuit under the supervision of the COCOM member country licensee;

   c. No means are to be provided for the transmission of traffic between points in one or more proscribed countries other than COCOM-agreed countries;

   d. The total length of optical fibre cable to be installed within the proscribed country, excluding cable in territorial waters, does not exceed 10 km or the shortest distance which is practical for installation;

   e. The "digital transfer rate" at the highest multiplex level does not exceed 565 Mbit/s;

   f. The "laser" transmission wavelength does not exceed 1550 nm;

   g. The equipment is not embargoed by 1051.b.4.b. to e. or 1054.2.;

   h. Spare parts shall remain under control of the COCOM member country licensee;

   i. The COCOM member country licensee or his designated representative, who shall be from a non-proscribed country, shall have the right of access to all the equipment;

   j. There will be no transfer of embargoed technology;

   k. Systems installation, operation and maintenance shall be performed by the licensee or the licensee's designated representative, who shall be from a non-proscribed country, using only personnel from non-proscribed countries, until such time as the Committee agrees otherwise;

   l. Upon request, the licensee shall carry out an inspection to establish that:

1. The system is being used for the intended civil purpose;

2. All the equipment exported under the provisions of this Note is being used for the stated end purpose and is still located at the installation sites.

After each inspection, the licensee shall report his findings to his authorities within one month. The Government of the exporting country must report any deviation from these conditions to the Committee.

m. Will be approved the case if no member country has raised an objection within four weeks of the receipt of complete information on the application.

8. Will be favourably considered the export of technology embargoed by this Category and of instrumentation, test equipment, components and specially designed "software" therefor, and materials end components embargoed by this Category or other Categories on this List, for modification or production of "stored programme controlled" circuit switching equipment or systems provided:
N.B.: Technology for general purpose computers is not eligible for treatment under this Note, i.e., it remains governed by Category 4;

a. The characteristics of the "stored programme controlled" circuit switching equipment or systems are limited to those which release them from embargo or make them eligible for treatment under relevant Administrative Exceptions Notes;

b. Modification of the "stored programme controlled" circuit switching equipment or systems is not permitted if any aspect of the design would result in exceeding the performance thresholds or features of the relevant Administrative Exception Notes;

c. Testing of large scale integrated (LSI) circuits or those with higher component densities is limited to go/no go tests;

N.B.: Sub-paragraph (c) above does not preclude exports of equipment or technology which would be possible according to the provisions of other Categories.

d. The specially designed "software" is that necessary to utilize the transferred technology, instrumentation and test equipment;

e. The manufacturing of the load tape by the licensee is limited to the addition to the generic "software" of the specific customer data and site parameters;

f. "Development" technology is not included;

g. The contract includes explicit conditions to ensure that:
   1. The "production" technology or "production" equipment is not re-re-exported or exported, either directly or indirectly, toanother proscribed destination;

   2. The supplier or licensor may appoint a representative who is entitled to verify that the "production" technology and "production" equipment or systems serve their intended use;

   3. Any modification of the capabilities or functions of the produced equipment must be approved by the supplier or licensor;

   4. The supplier's or licensor's personnel have right of access to all the facilities directly involved in the "production" of the "stored programme controlled" circuit switching equipment or systems;

   5. The "production" technology, "production" equipment and produced equipment or systems will be for civil end-use only;

h. System integration testing will be performed by the supplier or licensor, if it requires test tools which provide the licensee with the capability to recover source code or upgrade the system beyond the performance thresholds or features of the relevant Administrative Exceptions Notes;

i. The Committee shall approve the case if no member country has raised an objection within four (4) weeks of the receipt of complete information on the application;

N.B.: No export under the favourable consideration provisions of this Note shall establish a precedent for the approval of exports under other Categories in this List.

9. The Committee will favourably consider the export to COCOM-agreed countries of technology embargoed by this Category, and of instrumentation, test equipment, components and specially designed "software" therefor, and materials and components embargoed by this Category or other Categories on this List, for the modification or "production" of telecommunications equipment or systems eligible for treatment under Note 4, provided:

N.B.: Technology for general purpose computers is not eligible for treatment under this Note, i.e., it remains governed by Category 1040.

a. The characteristics of the telecommunications equipment or systems are limited to those eligible for treatment under Note 4;

b. Modification of the telecommunications equipment or systems is not permitted if any aspect of the design would result in exceeding the performance thresholds or features of Note 4;

c. Testing of large scale integrated (LSI) circuits or those with higher component densities is limited to go/no go tests;

N.B.: This sub-paragraph does not preclude exports of equipment or technology which would be possible according to the provisions of other Categories.

d. The specially designed "software" is that necessary to utilize the transferred technology, instrumentation and test equipment;

e. All "software" shall be exported in machine executable form only;

f. "Development" technology is not included;

g. The contract includes explicit conditions to ensure that:

1. The "production" technology or "production" equipment is not re-exported or exported, either directly or indirectly, to another proscribed destination;

2. The supplier or licensor may appoint a representative who is entitled to verify that the "production" technology and "production" equipment or systems serve their intended use;

3. Any modification of the capabilities or functions of the produced equipment must be approved by the supplier or licensor;

4. The supplier's or licensor's personnel have right of access to all the facilities directly involved in the "production" of the telecommunications equipment or systems;

5. The "production" technology, "production" equipment and produced equipment or systems will be for civil end-use only and not for re-export to COCOM proscribed destinations other than COCOM agreed countries;

h. System integration testing will be performed by the supplier or licensor, if it requires test tools which would provide the licensee with the capability to recover source code or upgrade the system beyond the performance thresholds or features of Note 4;

i. End-use reporting of the installed telecommunication equipment or systems will be provided in accordance with the provisions of Note 4;

j. The Committee will approve the case if no member country has raised an objection within four (4) weeks of the receipt of complete information on the application;

N.B.:

1. No export under the favourable consideration provisions of this Note shall establish a precedent for the approval of exports under other Categories in this List.

2. For each licence granted under this Note, the Government of the exporting country will require that the importer:

   a. Provide end-use assurances backed by his national authorities;

   b. Make available information as requested by the exporting country; and

   c. Allow on-site inspection if requested by the exporting country.

1150. INFORMATION SECURITY

NOTE:
The embargo status of "information security" equipment, "software", systems, application specific "assemblies", modules, integrated circuits, components or functions is defined in this Category even if they are components or "assemblies" of other equipment.

1151. Equipment, Assemblies and Components

Systems, equipment, application specific "assemblies", modules or integrated circuits for "information security", as follows, and other specially designed components therefor:

1151. a. Designed or modified to use "cryptography" employing digital techniques to ensure "information security";

b. Designed or modified to perform cryptanalytic functions;

c. Designed or modified to use "cryptography" employing analogue techniques to ensure "information security", except:

1. Equipment using "fixed" band scrambling not exceeding 8 bands and in which the transpositions change not more frequently than once every second;

2. Equipment using "fixed" band scrambling exceeding 8 bands and in which the transpositions change not more frequently than once every ten seconds;

3. Equipment using "fixed" frequency inversion and in which the transpositions change not more frequently than once every second;

4. Facsimile equipment;

5. Restricted audience broadcast equipment;

6. Civil television equipment;

d. Designed or modified to suppress the compromising emanations of information-bearing signals;

NOTE:
1151.d. does not embargo equipment specially designed to suppress emanations for health or safety reasons.

e. Designed or modified to use cryptographic techniques to generate the spreading code for "spread spectrum" or the hopping code for "frequency agility" systems;

f. Designed or modified to provide certified or certifiable "multilevel security" or user isolation at a level exceeding Class B2 of the Trusted Computer System Evaluation Criteria (TCSEC) or equivalent;

g. Communications cable systems designed or modified using mechanical, electrical or electronic means to detect surreptitious intrusion;

1152. Test, Inspection and Production Equipment

1152. a. Equipment specially designed for:

1. The development of equipment or functions embargoed by 1151., 1152., 1054. or 1155., including measuring or test equipment;

2. The production of equipment or functions embargoed by 1151., 1152., 1154. or 1155., including measuring, test, repair or production equipment;

b. Measuring equipment specially designed to evaluate and validate the "information security" functions embargoed by 1151. or 1154.

1153. Materials

None.

1154. Software

1154. a. "Software" specially designed or modified for the "development", "production" or "use" of equipment or "software" embargoed by 1151., 1152. or 1154.;

b. "Software" specially designed or modified to support technology embargoed by 1155.;

c. Specific "software" as follows:

1. "Software" having the characteristics, or performing or simulating the functions of the equipment embargoed by 1151. or 1152.;

2. "Software" to certify "software" embargoed by 1154.c.1.;

3. "Software" designed or modified to protect against malicious computer damage, e.g., viruses;

1155. Technology

Technology according to the General Technology Note for the "development", "production" or "use" of equipment or "software" embargoed by 1151., 1152. or 1154.

NOTES:

1. 1151. does not embargo:

   a. Personalized smart cards" using "cryptography" restricted for use only in equipment or systems excluded from embargo under 1151.c.1. to 6., under Note 1.b. to e., or as described in Notes 3 and 4;

   b. Equipment containing "fixed" data compression or coding techniques;

   c. Receiving equipment for radio broadcast, pay television or similar restricted audience television of the consumer type, without digital encryption and where digital decryption is limited to the video, audio or management functions;

   d. Portable (personal) or mobile radiotelephones for civil use, e.g., for use with commercial civil cellular radio-communications systems, containing encryption, when accompanying their users;

   e. Decryption functions specially designed to allow the execution of copy-protected "software", provided the decryption functions are not user-accessible.

2. 1150. does not embargo:

   a. "Software" "required" for the "use" of equipment excluded from embargo under Note 1;

   b. "Software" providing any of the functions of equipment excluded from embargo under Note 1.

3. Governments may permit, as administrative exceptions, the shipment to COCOM-agreed countries of cellular radio equipment or systems specially designed for cryptographic operation, provided any message traffic encryption capability within the scope of the embargo under this Category contained in such equipment or systems is irreversibly disabled.

N.B.: Provided message traffic encryption is not possible within such a system, the export of mobile or portable cellular radio subscriber equipment containing cryptographic capabilities is permitted under this Note.

4. Governments may permit, as administrative exceptions, the shipment of the following cryptographic equipment, provided they are reasonably satisfied that the equipment is intended for civil use:

   a. Access control equipment, such as automatic teller machines, self-service statement printers or point of sale terminals, which protects password or personal identification numbers (PIN) or similar data to prevent unauthorized access to facilities but does not allow for encryption of files or text, except as directly related to the password or PIN protection;

   b. Data authentication equipment which calculates a Message Authentication Code (MAC) or similar result to ensure no alteration of text has taken place, or to authenticate users, but does not allow for encryption of data, text or other media other than that needed for the authentication;

   c. Cryptographic equipment specially designed, developed or modified for use in machines for banking or money transactions, such as automatic teller machines, self-service statement printers, point of sale terminals, or equipment for the encryption of interbanking transactions, and intended for use only in such applications.

5. Governments may permit, as administrative exceptions, the shipment of the following cryptographic "software":
   a. "Software" "required" for the "use" of equipment eligible for Administrative Exceptions under Notes 3 and 4;

   b. "Software" providing any of the functions of equipment eligible for Administrative Exceptions under Notes 3 and 4.

1060. SENSORS AND LASERS

1061. Equipment, Assemblies and Components

1061. 1. Acoustics

a. Marine acoustic systems, equipment or specially designed components therefor, as follows:

   1. Active (transmitting or transmitting-and-receiving) systems, equipment or specially designed components therefor, as follows:

NOTE:
1061.1.a.1. does not embargo depth sounders operating vertically below the apparatus, not including a scanning function exceeding ±10°, and limited to measuring the depth of water, the distance of submerged or buried objects or fish finding.

1061. 1. a. 1. a. Wide-swath bathymetric survey systems for sea bed topographic mapping:

1. Designed:

    a. To take measurements at an angle exceeding 10° from the vertical; and

    b. To measure depths exceeding 600 m below the water surface; and

2. Designed:

    a. To incorporate multiple beams any of which is less than 2°; or

    b. To provide data accuracies of better than 0.5% of water depth across the swath averaged over the individual measurements within the swath;

1061. 1. a. 1. b. Object detection or location systems having any of the following:

1. A transmitting frequency below 10 kHz;

2. Sound pressure level exceeding 224 dB (reference 1 micropascal at 1 m) for equipment with an operating frequency in the band from 10 kHz to 24 kHz inclusive;

3. Sound pressure level exceeding 235 dB (reference 1 micropascal at 1 m) for equipment with an operating frequency in the band between 24 kHz and 30 kHz;

4. Forming beams of less than 1° on any axis and having an operating frequency of less than 100 kHz;

5. Designed to withstand pressure during normal operation at depths exceeding 1,000 m and having transducers:
   - a. Dynamically compensated for pressure; or
   - b. Incorporating other than lead zirconate titanate as the transduction element; or

6. Designed to measure distances to objects at ranges exceeding 5,120 m;

1061. 1. a. 1. c. Acoustic projectors, including transducers, incorporating piezoelectric, magnetostrictive, electrostrictive, electrodynamic or hydraulic elements operating individually or in a designed combination, having any of the following:

NOTE:
The embargo status of acoustic projectors, including transducers, specially designed for other equipment is determined by the embargo status of the other equipment.

1. An instantaneous radiated acoustic power density exceeding 0.01 mW /mm²/Hz for devices operating at frequencies below 10 kHz;

2. A continuously radiated acoustic power density exceeding 0.001 mW/ mm²/Hz for devices operating at frequencies below 10 kHz;

Technical Note:
Acoustic power density is obtained by dividing the output acoustic power by the product of the area of the radiating surface and the frequency of operation.

3. Designed to withstand pressure during normal operation at depths exceeding 1,000 m; or

4. Side-lobe suppression exceeding 22 dB;

NOTE:
1061.1.a.1.c. does not embargo electronic sources which direct the sound vertically only, or mechanical (e.g., air gun or vapour-shock gun) or chemical (e.g., explosive) sources.

1061. 1. a. 1. d. Acoustic systems, equipment or specially designed components for determining the position of surface vessels or underwater vehicles designed:

NOTE:
1061.1.a.1.d. includes equipment using coherent "signal processing" between two or more beacons and the hydrophone unit carried by the surface vessel or underwater vehicle, or capable of automatically correcting speed-of-sound propagation errors for calculation of a point.

1. To operate at a range exceeding 1,000 m with a positioning accuracy of less than 10 m rms (root mean square) when measured at a range of 1,000 m; or

2. To withstand pressure at depths exceeding 1,000 m;

1061. 1. a. 2. Passive (receiving, whether or not related in normal application to separate active equipment) systems, equipment or specially designed components therefor, as follows:

a. Hydrophones (transducers) with any of the following characteristics:

1. Incorporating continuous flexible sensors or assemblies of discrete sensor elements with either a diameter or length less than 20 mm and with a separation between elements of less than 20 mm;

2. Having any of the following sensing elements:

a. Optical fibres;

b. Piezoelectric polymers; or

c. Flexible piezoelectric ceramic materials

3. Hydrophone sensitivity better than -180 dB at any depth with no acceleration compensation;

4. When designed to operate at depths not exceeding 35 m, hydrophone sensitivity better than -186 dB with acceleration compensation;

5. When designed for normal operation at depths exceeding 35 m, hydrophone sensitivity better than -192 dB with acceleration compensation;

6. When designed for normal operation at depths exceeding 100 m, hydrophone sensitivity better than -204 dB; or

7. Designed for operation at depths exceeding 1,000 m;

Technical Note:
Hydrophone sensitivity is defined as twenty times the logarithm to the base 10 of the ratio of rms output voltage to a 1 V rms reference, when the hydrophone sensor, without a pre-amplifier, is placed in a plane wave acoustic field with an rms pressure of 1 micropascal. For example, a hydrophone of -160 dB (reference 1 V per micropascal) would yield an output voltage of 10^{-8} V in such a field, while one of -180 dB sensitivity would yield only 10^{-9} V output. Thus, -160 dB is better than -180 dB.

1061. 1. a. 2. b. Towed acoustic hydrophone arrays with:

1. Hydrophone group spacing of less than 12.5 m;

2. Hydrophone group spacing of 12.5 m to less than 25 m and designed or able to be modified to operate at depths exceeding 35 m; or

Technical Note:
'Able to be modified' in 1061.1.a.2.b.2. means having provisions to allow a change of the wiring or interconnections to alter hydrophone group spacing or operating depth limits. These provisions are: spare wiring exceeding 10% of the number of wires, hydrophone group spacing adjustment blocks or internal depth limiting devices that are adjustable or that control more than one hydrophone group.

3. Hydrophone group spacing of 25 m or more and designed to operate at depths exceeding 100 m;

4. Heading sensors:

   a. Having an accuracy of better than ±0.5°;

   b. Incorporated within the array hosing and designed or able to be modified to operate at depths exceeding 35 m; or

Technical Note:
'Able to be modified' in 1061.1.a.2.b.4.b. means having an adjustable or removable depth sensing device.

   c. Mounted external to the array hosing and having a sensor unit capable of operating with 36° roll at depths exceeding 35 m;

5. Non-metallic strength members or longitudinally reinforced array hoses;

6. An assembled array of less than 40 mm in diameter;

7. Multiplexed hydrophone group signals; or

8. Hydrophone characteristics specified in 1061.1.a.2.a.;

1061. 1. a. 2. c. Processing equipment, specially designed for towed acoustic hydrophone arrays, with either of the following:

1. A Fast Fourier or other transform of 1024 or more complex points in less than 20 ms with no "user-accessible programmability"; or

2. Time or frequency domain processing and correlation, including spectral analysis, digital filtering and beamforming using Fast Fourier or other transforms or processes with "user accessible programmability";

1061. 1. b. Terrestrial geophones capable of conversion for use in marine systems, equipment or specially designed components embargoed by 1061.1.a.2.a.;

1061. 1. c. Correlation-velocity sonar log equipment designed to measure the horizontal speed of the equipment carrier relative to the sea bed at distances between the carrier and the sea bed exceeding 500 m;

1061. 2. Optical Sensors

a. Optical detectors, as follows:

NOTE:
1061.2.a. does not embargo germanium or silicon photodevices.

1. "Space-qualified" single-element or focal plane array (linear or two dimensional) elements having any of the following:

   a. 1. A peak response at a wavelength shorter than 300 nm; and

      2. A response of less than 0.1% relative to the peak response at a wavelength exceeding 400 nm;

   b. 1. A peak response in the wavelength range exceeding 900 nm but not exceeding 1,200 nm; and
      2. A response "time constant" of 95 ns or less; or

   c. A peak response in the wavelength range exceeding 1,200 nm but not exceeding 30,000 nm;

1061. 2. a. 2. Image intensifier tubes and specially designed components therefor, as follows:

   a. Image intensifier tubes having all of the following:

      1. A peak response in the wavelength range exceeding 400 nm but not exceeding 1,050 nm;

      2. A microchannel plate for electron image amplification with a hole pitch (centre-to-centre spacing) of less than 25 micrometres; and

3. a. An S-20, S-25 or multialkali photocathode; or
   b. A GaAs or GaInAs photocathode;

b. Specially designed components, as follows:

1. Fibre optic image inverters;

2. Microchannel plates having both of the following characteristics:

   a. 15,000 or more hollow tubes per plate; and
   b. Hole pitch (centre-to-centre spacing) of less than 25 micrometres;

3. GaAs or GaInAs photocathodes;

1061. 2. a. 3. Non-"space-qualified" linear or two dimensional focal plane arrays, having any of the following:

NOTES:

1. 1061.2.a.3. includes photoconductive arrays and photovoltaic arrays.

2. 1061.2.a.3.does not embargo silicon focal plane arrays, multi-element (not to exceed 16 elements) encapsulated photoconductive cells or pyroelectric detectors using any of the following:
   a. Lead sulphide;

   b. Triglycine sulphate and variants;

   c. Lead-lanthanum-zirconium titanate and variants;

   d. Lithium tantalate;

   e. Polyvinylidene fluoride and variants;

   f. Strontium barium niobate and variants; or

   g. Lead selenide.

1061. 2. a. 3. a. 1. Individual elements with a peak response within the wavelength range exceeding 900 nm but not exceeding 1,050 nm; and

2. A response "time constant" of less than 0.5 ns;

b. 1. Individual elements with a peak response in the wavelength range exceeding 1,050 nm but not exceeding 1,200 nm; and

2. A response "time constant" of 95 ns or less; or

c. Individual elements with a peak response in the wavelength range exceeding 1,200 nm but not exceeding 30,000 nm;

1061. 2. a. 4. Non-"space-qualified" single-element or non-focal-plane multi-element semiconductor photodiodes or phototransistors having both of the following:

a. A peak response at a wavelength exceeding 1,200 nm; and

b. A response "time constant" of 0.5 ns or less;

1061.2. b. "Multispectral imaging sensors" designed for remote sensing applications, having either of the following characteristics:

1. An Instantaneous-Field-Of-View (IFOV) of less than 200 microradians; or

2. Specified for operation in the wavelength range exceeding 400 nm but not exceeding 30,000 nm; and

a. Providing output imaging data in digital format; and

b. 1. "Space-qualified"; or

2. Designed for airborne operation and using other than silicon detectors;

1061.2. c. Direct view imaging equipment operating in the visible or infrared spectrum, incorporating either of the following:

1. Image intensifier tubes embargoed by 1061.2.a.2.; or
2. Focal plane arrays embargoed by 1061.2.a.3.;

Technical Note:
'Direct view' refers to imaging equipment, operating in the visible or infrared spectrum, that presents a visual image to a human observer without converting the image into an electronic signal for television display, and that cannot record or store the image photographically, electronically or by any other means.

NOTE:
1061.2.c. does not embargo the following equipment incorporating other than GaAs or GaInAs photocathodes:

a. Industrial or civilian intrusion alarm, traffic or industrial movement control or counting systems;

b. Medical equipment;

c. Industrial equipment used for inspection, sorting or analysis of the properties of materials;

d. Flame detectors for industrial furnaces;

e. Equipment specially designed for laboratory use.

1061.2. d. Special support components for optical sensors, as follows:

1. "Space-qualified" cryocoolers;

2. Non-"space-qualified" cryocoolers, as follows:

a. Closed cycle with a specified Mean-Time-To-Failure (MTTF), or Mean-Time-Between-Failures (MTBF), exceeding 2,500 hours;
b. Joule-Thomson (JT) self-regulating minicoolers for bore diameters of less than 8 mm;

3. Optical sensing fibres:

a. Specially fabricated either compositionally or structurally, or modified by coating, to be acoustically, thermally, inertially, electromagnetically or nuclear radiation sensitive; or

b. Modified structurally to have a "beat length" of less than 50 mm (high birefringence);

4. Ingot feed rate or material vapourisation rate;
5. Time-temperature-pressure cycles;
6. Beam and part manipulation;
7. "Laser" parameters, as follows:
   a. Wave length;
   b. Power density;
   c. Pulse length;
   d. Repetition ratio;
   e. Source;
   f. Substrate orientation;

c. For Pack Cementation:
   1. Pack composition and formulation;
   2. Carrier gas composition;
   3. Time-temperature-pressure cycles;

d. For Plasma Spraying:
   1. Powder composition, preparation and size distributions;
   2. Feed gas composition and parameters;
   3. Substrate temperature;
   4. Gun power parameters;
   5. Spray distance;
   6. Spray angle;
   7. Cover gas composition, pressure and flow rates;
   8. Gun control and part manipulation;

e. For Sputter Deposition:

   1. Target composition and fabrication;
   2. Geometrical positioning of part and target;
   3. Reactive gas composition;
   4. Electrical bias;
   5. Time-temperature-pressure cycles;
   6. Triode power;
   7. Part manipulation;

f. For Ion Implantation:

   1. Beam control and part manipulation;
   2. Ion source design details;
   3. Control techniques for ion beam and deposition rate parameters;
   4. Time-temperature-pressure cycles.

g. For Ion Plating:

   1. Beam control and part manipulation;
   2. Ion source design details
   3. Control techniques for ion beam and deposition rate parameters;
   4. Time-temperature-pressure cycles;
   5. Coating material feed rate and vapourisation rate;
   6. Substrate temperature;
   7. Substrate bias parameters.

1030. ELECTRONICS

1031. Equipment, Assemblies and Components

1031. NOTES:

1. The embargo status of equipment, devices and components described in 1031, other than those described in 1031.1.a.3.to 10., which are specially designed or which have the same functional characteristics as other equipment is determined by the embargo status of the other equipment.

2. The embargo status of integrated circuits described in 1031.1.a.3.to 9. which are unalterably programmed or designed for a specific function is determined by the embargo status of the other equipment.
   N.B.: When the manufacturer or applicant cannot determine the embargo status of the other equipment, the embargo status of the integrated circuits is determined in 1031.1.a.3. to 9.

1031. 1. Electronic devices and components:

a. General purpose integrated circuits, as follows:

NOTES:

1. The embargo status of wafers (finished or unfinished), in which the function has been determined, is to be evaluated against the parameters of 1031.1.a.

2. Integrated circuits include the following types:
   "Monolithic integrated circuits";
   "Hybrid integrated circuits";
   "Multichip integrated circuits";
     "Film type integrated circuits", including silicon-on-sapphire integrated circuits;
     "Optical integrated circuits".

1031. 1. a. 1. Integrated circuits, designed or rated as radiation hardened to withstand a total dose of 5 X 10^3 rad (Si), or higher; (For integrated ircuits designed or rated against neutron or transient ionizing radiation, see the Munitions List.)

1031. 1. a. 2. Integrated circuits described in 1031.1.a.3 to 10, rated for operation at an ambient temperature below 219 K (-54" C) or above 398 K (125" C);

NOTE:
1031.1.a.2. does not apply to integrated circuits for civil automobiles or railway engines.

1031. 1. a. 3. "Microprocessor microcircuits", "microcomputer microcircuits" and microcontroller microcircuits, having any of the following:

NOTES:

1. 1031.1.a.3. does not embargo silicon-based "microcomputer microcircuits" or microcontroller microcircuits having an operand (data) word length of 8 bit or less and not covered by Note 2 to 1031.

2. 1031.1.a.3. includes digital signal processors, digital array processors and digital coprocessors.

1031. 1. a. 3. a. An external data bus width exceeding 32 bit or an arithmetic logic unit with an access width exceeding 32 bit;

b. A clock frequency exceeding 40 MHz;

c. An external data bus width of 32 bit or more and capable of executing 12.5 million instructions per second (MIPS) or more; or

Technical Note:
If MIPS are not specified, the inverse of the average instruction cycle time (in microseconds) should be used.

d. More than one data or instruction bus or serial communication port for external interconnection in a parallel processor with a transfer rate exceeding 2.4 Mbyte/s;

1031. 1. a. 4. Storage integrated circuits, as follows:

a. Electrical erasable programmable read-only memories (EEPROMs) with a storage capacity:

1. Exceeding 1 Mbit per package; or
2. Exceeding 256 kbit per package and a maximum access time of less than 80 ns;

b. Static random-access memories (SRAMs) with a storage capacity:

1. Exceeding 1 Mbit per package; or
2. Exceeding 256 kbit per package and a maximum access time of less than 25 ns;

c. Storage integrated circuits manufactured from a compound semiconductor;

1031. 1. a. 5. Converter integrated circuits, as follows:

a. Analogue-to-digital converters having any of the following:

1. A resolution of 8 bit or more, but less than 12 bit, with a total conversion time to maximum resolution of less than 10 ns;
2. A resolution of 12 bit with a total conversion time to maximum resolution of less than 200 ns;or
3. A resolution of more than 12 bit with a total conversion time to maximum resolution of less than 2 microseconds;

b. Digital-to-analogue converters with a resolution of 12 bit or more, and a "settling time" of less than 10 ns;

1031. 1. a. 6. Electro-optical or "optical integrated circuits" for "signal processing" having all of the following:
a. One or more internal "laser" diodes;
b. One or more internal light detecting elements; and
c. Optical waveguides;

1031. 1. a. 7. Field programmable gate arrays having either of the following:

a. An equivalent gate count of more than 30,000 (2 input gates); or

b. A typical "basic gate propagation delay time" of less than 0.4 ns;

1031. 1. a. 8. Field programmable logic arrays having either of the following:

a. An equivalent gate count of more than 5,000 (2 input gates); or

b. A toggle frequency exceeding 100 MHz;

1031. 1. a. 9. Neural network integrated circuits;

1031. 1. a. 10. Custom integrated circuits for which either the function is unknown, or the embargo status of the equipment in which the integrated circuits will be used is unknown to the manufacturer, having any of the following:

a. More than 144 terminals;

b. A typical "basic gate propagation delay time" of less than 0.4 ns; or

c. An operating frequency exceeding 3 GHz;

1031. 1. a. 11. Digital integrated circuits, other than those described in 1031.1.a.3 to 10., based upon any compound semiconductor and having either of the following:

a. An equivalent gate count of more than 300 (2 input gates); or

b. A toggle frequency exceeding 1.2 GHz;

1031. 1. b. Microwave or millimetre wave devices:

1. Electronic vacuum tubes and cathodes, as follows: (For "frequency agile" tubes, see Item 2011 on the Munitions List.)

NOTE:

1031.1.b.1.does not embargo tubes designed or rated to operate in the Standard Civil Telecommunications Bands at frequencies not exceeding 31 GHz.

a. Travelling wave tubes, pulsed or continuous wave, as follows:
   1. Operating at frequencies higher than 31 GHz;
   2. Having a cathode heater element with a turn on time to rated RF power of less than 3 seconds;
   3. Coupled cavity tubes, or derivatives thereof;
   4. Helix tubes, or derivatives thereof, with any of the following:
      a. 1. An "instantaneous bandwidth" of half an octave or more; and
         2. The product of the rated average ouput power (expressed in kW) and the maximum operating frequency (expressed in GHz) of more than 0.2;
      b. 1. An "instantaneous bandwidth" of less than half an octave; and
         2. The product of the rated average ouput power (expressed in kW) and the maximum operating frequency (expressed in GHz) of more than 0.4; or
      c. "Space qualified";

b. Crossed-field amplifier tubes with a gain of more than 17 dB;

c. Impregnated cathodes for electronic tubes, with either of the following:
   1. Having a turn on time to rated emission of less than 3 seconds; or
   2. Producing a continuous emission current density at rated operating conditions exceeding 5 A/cm^2;

1031.1.b. 2. Microwave integrated circuits or modules containing "monolithic integrated circuits" operating at frequencies exceeding 3 GHz;

NOTE: 1031.1.b.2. does not embargo circuits or modules for equipment designed or rated to operate in the Standard Civil Telecommunications Bands at frequencies not exceeding 31 GHz.

1031.1.b. 3. Microwave transistors rated for operation at frequencies exceeding 31 GHz;

1031.1.b. 4. Microwave solid state amplifiers, as follows:

a. Operating at frequencies exceeding 10.5 GHz and having an "instantaneous bandwidth" of more than half an octave;

b. Operating at frequencies exceeding 31 GHz;

NOTE: 1031.1.b.4. does not embargo amplifiers:

1. Specially designed for medical applications;

2. Specially designed for use in "simple educational devices"; or

3. Having an output power of no more than 10 W and specially designed for:

a. Industrial or civilian intrusion, detection and alarm systems;

b. Traffic or industrial movement control and counting systems; or

c. Systems for the detection of environmental pollution of air or water.

1031.1.b. 5. Electronically or magnetically tunable band-pass or band-stop filters having more than 5 tunable resonators capable of tuning across a 1.5:1 frequency band (f_{max}/f_{min}) in less than 10 microseconds with:

a. A band-pass bandwidth of more than 0.5% of centre frequency; or

b. A band-stop bandwidth of less than 0.5% of centre frequency;

1031.1.b. 6. Microwave assemblies capable of operating at frequencies exceeding 31 GHz;

1031.1.b. 7. Flexible waveguides designed for use at frequencies exceeding 40 GHz;

1031. 1. c. Acoustic wave devices, as follows, and specially designed components therefor:

1031.1.c. 1. Surface acoustic wave and surface skimming (shallow bulk) acoustic wave devices (i.e., "signal processing" devices employing elastic waves in materials), having either of the following:

NOTE: 1031.1.c.1. does not embargo devices specially designed for home electronics or entertainment.

- a. A carrier frequency exceeding 1 GHz; or
- b. A carrier frequency of 1 GHz or less, and:
    - 1. A frequency side-lobe rejection exceeding 55 dB;
    - 2. A product of the maximum delay time and the bandwidth (time in microseconds and bandwidth in MHz) of more than 100; or
    - 3. A dispersive delay of more than 10 microseconds;

1031.1.c. 2. Bulk (volume) acoustic wave devices (i.e., "signal processing" devices employing elastic waves) which permit direct processing of signals at frequencies exceeding 1 GHz;

1031.1.c. 3. Acoustic-optic "signal processing" devices employing interaction between acoustic waves (bulk wave or surface wave) and light waves which permit the direct processing of signals or images, including spectral analysis, correlation or convolution;

NOTE:
1031.1.c.3. does not embargo devices specially designed for civil television, video or AM and FM broadcasting equipment.

1031. 1. d. Electronic devices or circuits containing components, manufactured from "superconductive" materials specially designed for operation at temperatures below the "critical temperature" of at least one of the "superconductive" constituents, with any of the following:

1. Electromagnetic amplification:
    a. At frequencies equal to or less than 31 GHz with a noise figure of less than 0.5 dB; or
    b. At frequencies exceeding 31 GHz;
2. Current switching for digital circuits using "superconductive" gates with a product of delay time per gate (in seconds) and power dissipation per gate (in watts) of less than 10^{-14} J; or
3. Frequency selection at all frequencies using resonant circuits with Q-values exceeding 10,000;

1031. 1. e. High energy devices, as follows:

1. Batteries, as follows:

    NOTE:
    1031.1.e.1. does not embargo batteries with volumes equal to or less than 26 cm^3 (e.g., standard C-cells or UM-2 batteries).

    a. Primary cells and batteries having an energy density exceeding 350 Wh/kg and rated for operation in the temperature range from below 243 K (-30° C) to above 343 K (70° C);
    b. Rechargeable cells and batteries having an energy density exceeding 150 Wh/kg after 75 charge/discharge cycles at a discharge current equal to C/5 hours (C being the nominal capacity in ampere hours) when operating in the temperature range from below 253 K (-20° C) to above 333 K (60° C);

Technical Note:
Energy density is obtained by multiplying the average power in watts (average voltage in volts times average current in amperes) by the duration of the discharge in hours to 75% of the open circuit voltage divided by the total mass of the cell (or battery) in kg.

    c. "Space qualified" and radiation hardened photovoltaic arrays with a specific power exceeding 160 W/m^2 at an operating temperature of 301 K (28° C) under a tungsten illumination of 1 kW/m^2 at 2,800 K (2,527° C);

1031.1.e. 2. High energy storage capacitors, as follows:

a. Capacitors with a repetition rate of less than 10 Hz (single shot capacitors) having all of the following:

1. A voltage rating equal to or more than 5 kV;

2. An energy density equal to or more than 250 J/kg; and

3. A total energy equal to or more than 25 kJ;

b. Capacitors with a repetition rate of 10 Hz or more (repetition rated capacitors) having all of the following:

1. A voltage rating equal to or more than 5 kV;

2. An energy density equal to or more than 50 J/kg;

3. A total energy equal to or more than 100 J; and

4. A charge/discharge cycle life equal to or more than 10,000;

1031.1.e. 3. "Superconductive" electromagnets or solenoids specially designed to be fully charged or discharged in less than one minute, having all of the following:

NOTE:
1031.1.e.3. does not embargo "superconductive" electromagnets or solenoids specially designed for Magnetic Resonance Imaging (MRI) medical equipment.

a. Maximum energy delivered during the discharge divided by the duration of the discharge of more than 500 kJ per minute;

b. Inner diameter of the current carrying windings of more than 250 mm; and

c. Rated for a magnetic induction of more than 8 T or "overall current density" in the winding of more than 300 A/mm²;

1031.1.e. 4. Circuits or systems for electromagnetic energy storage, containing components manufactured from "superconductive" materials specially designed for operation at temperatures below the "critical temperature" of at least one of their "superconductive" constituents, having all of the following:

- a. Resonant operating frequencies exceeding 1 MHz;
- b. A stored energy density of 1 MJ/m^3 or more; and
- c. A discharge time of less than 1 ms;

1031.1.e. 5. Flash discharge type X-ray systems, including tubes, having all of the following:

- a. A peak power exceeding 500 MW;
- b. An output voltage exceeding 500 kV; and
- c. A pulse width of less than 0.2 microsecond;

1031. 1. f. Rotary input type shaft absolute position encoders having either of the following:

- 1. A resolution of better than 1 part in 265,000 (18 bit resolution) of full scale; or
- 2. An accuracy better than ±2.5 seconds of arc;

1031. 2. General purpose electronic equipment:

- a. Recording equipment, as follows, and specially designed test tape therefor:
  - 1. Analogue instrumentation magnetic tape recorders, including those permitting the recording of digital signals (e.g., using a high density digital recording (HDDR) module), having any of the following:
    - a. A bandwidth exceeding 4 MHz per electronic channel or track;
    - b. A bandwidth exceeding 2 MHz per electronic channel or track and having more than 42 tracks; or
    - c. A time displacement (base) error, measured in accordance with applicable IRIG or EIA documents, of less than ±0.1 microsecond;

2. Digital video magnetic tape recorders having a maximum digital interface transfer rate exceeding 180 Mbit/s, except those specially designed for television recording as standardized or recommended by the CCIR or the IEC for civil television applications;

3. Digital instrumentation magnetic tape data recorders having any of the following characteristics:

    a. A maximum digital interface transfer rate exceeding 60 Mbit/s and employing helical scan techniques;

    b. A maximum digital interface transfer rate exceeding 120 Mbit/s and employing fixed head techniques; or

    c. "Space qualified";

    NOTE:
    1031.2.a.3 does not embargo analogue magnetic tape recorders equipped with HDDR conversion electronics and configured to record only digital data.

4. Equipment, with a maximum digital interface transfer rate exceeding 60 Mbit/s, designed to convert digital video magnetic tape recorders for use as digital instrumentation data recorders;

1031.2. b. "Frequency synthesiser" "assemblies" having a "frequency switching time" from one selected frequency to another of less than 1 ms;

1031.2. c. "Signal analysers", as follows:

1. Capable of analysing frequencies exceeding 31 GHz;
2. "Dynamic signal analysers" with a "real-time bandwidth" exceeding 25.6 kHz, except those using only constant percentage bandwidth filters (also known as octave or fractional octave filters);

1031.2. d. Frequency synthesized signal generators producing output frequencies, the accuracy and short-term and long-term stability of which are controlled, derived from or disciplined by the internal master frequency, and having any of the following:

1. A maximum synthesised frequency exceeding 31 GHz;

2. A "frequency switching time" from one selected frequency to another of less than 1 ms; or

3. A single sideband (SSB) phase noise better than ($126 + 20 \log_{10}F - 20 \log_{10}f$) in dBc/Hz, where F is the off-set from the operating frequency in Hz and f is the operating frequency in MHz;

   NOTE:
   1031.2.d. does not embargo equipment in which the output frequency is either produced by the addition or subtraction of two or more crystal oscillator frequencies, or by an addition or subtraction followed by a multiplication of the result.

1031.2. e. Network analysers with a maximum operating frequency exceeding 31 GHz;

NOTE:
1031.2.e. does not embargo "swept frequency network analysers" with a maximum operating frequency not exceeding 40 GHz and which do not contain a data bus for remote control interfacing.

1031.2. f. Microwave test receivers with both of the following:

1. A maximum operating frequency exceeding 31 GHz; and

2. Capable of measuring amplitude and phase simultaneously;

1031.2. g. Atomic frequency standards having either of the following characteristics:

1. Long term stability (aging) less (better) than 1×10^{-11}/month; or

2. "Space qualified";

   NOTE:
   1031.2.g.1. does not embargo non-"space qualified" rubidium standards.

1031.2. h. Emulators for microcircuits embargoed by 1031.1.a.3. or 1031.1.a.9.;

NOTE:
1031.2.h. does not embargo emulators designed for a "family" which contains at least one device not embargoed by 1031.1.a.3. or 1031.1.a.9.

1032. Test, Inspection and Production Equipment

1032. Equipment for the manufacture or testing of semiconductor devices or materials, as follows, and specially designed components and accessories therefor:

1. "Stored programme controlled" equipment for epitaxial growth, as follows:

   a. Capable of producing a layer thickness uniform to less than ±2.5% across a distance of 75 mm or more;

   b. Metal organic chemical vapour deposition (MOCVD) reactors specially designed for compound semiconductor crystal growth by the chemical reaction between materials embargoed by 1033.3 or 1033.4;

   c. Molecular beam epitaxial growth equipment using gas sources;

1032.2. "Stored programme controlled" equipment designed for ion implantation, having any of the following:

   a. An accelerating voltage exceeding 200 keV;

   b. Specially designed and optimized to operate at an accelerating voltage of less than 10 keV;

   c. Direct write capability; or

   d. Capable of high energy oxygen implant into a heated semiconductor material "substrate";

1032.3. "Stored programme controlled" anisotropic plasma dry etching equipment, as follows:

   a. With cassette-to-cassette operation and load-locks, and having either of the following:

      1. Magnetic confinement; or
      2. Electron cyclotron resonance (ECR);

   b. Specially designed for equipment embargoed by 1032.6. and having either of the following:

1. Magnetic confinement; or
2. Electron cyclotron resonance (ECR);

1032.4. "Stored programme controlled" plasma enhanced CVD equipment, as follows:

a. With cassette-to-cassette operation and load-locks, and having either of the following:

   1. Magnetic confinement; or
   2. Electron cyclotron resonance (ECR);

b. Specially designed for equipment embargoed by 1032.6. and having either of the following:

   1. Magnetic confinement; or
   2. Electron cyclotron resonance (ECR);

1032.5. "Stored programme controlled" multifunctional focussed ion beam systems specially designed for manufacturing, repairing, physical layout analysis and testing of masks or semiconductor devices, having either of the following:

a. Target-to-beam position feedback control precision of 0.25 micrometre or finer; or

b. Digital-to-analogue conversion resolution exceeding 12 bit;

1032.6. "Stored programme controlled" automatic loading multi-chamber central wafer handling systems, having interfaces for wafer input and output, to which more than two pieces of semiconductor processing equipment are to be connected, to form an integrated system in a vacuum environment for sequential multiple wafer processing;

NOTE:
1032.6. does not embargo automatic robotic wafer handling systems not designed to operate in a vacuum environment.

1032.7. "Stored programme controlled" lithography equipment, as follows:

a. Align and expose step and repeat equipment for wafer processing using photo-optical or X-ray methods, having any of the following:

   1. A light source wavelength shorter than 400 nm;

   2. A numerical aperture more than 0.40; or

3. An overlay accuracy of ±0.20 micrometre (3 sigma) or better;

NOTE:
1032.7.a. does not embargo align and expose step and repeat equipment having all of the following:

1. A light source wavelength of 436 nm or more;

2. A numerical aperture 0.38 or less; and

3. An image size diameter 22 mm or less.

1032.7. b. Equipment specially designed for mask making or semiconductor device processing using deflected focussed electron beam, ion beam or "laser" beam, with any of the following:

1. A spot size smaller than 0.2 micrometre;

2. Capable of producing a pattern with a feature size of less than 1 micrometre; or an overlay accuracy of better than ± 0.20 micrometre (3 sigma);

1032.8. Masks or reticles, as follows:

a. For integrated circuits embargoed by 1031.1;

b. Multi-layer masks with a phase shift layer;

1032.9. "Stored programme controlled" test equipment, specially designed for testing semiconductor devices and unencapsulated dice, as follows:

a. For testing S-parameters of transistor devices at frequencies exceeding 31 GHz;

b. For testing integrated circuits, and "assemblies" thereof, and capable of performing functional (truth table) testing at a pattern rate of more than 40 MHz;

c. For testing microwave integrated circuits at frequencies exceeding 3 GHz;

NOTE:
1032.9.c. does not embargo test equipment specially designed for testing microwave integrated circuits for equipment designed or rated to operate in the Standard Civil Telecommunication Bands at frequencies not exceeding 31 GHz.

d. Electron beam systems designed for operation at or below 3 keV, or "laser" beam systems, for the non-contactive probing of powered-up semiconductor devices, with both of the following:

1. Stroboscopic capability with either beam-blanking or detector strobing; and

2. An electron spectrometer for voltage measurement with a resolution of less than 0.5 V;

NOTE:
1032.9.d. does not embargo scanning electron microscopes, except when specially designed and instrumented for the non-contactive probing of powered-up semiconductor devices.

1033. Materials

1033. 1. Hetero-epitaxial materials consisting of a "substrate" with stacked epitaxially grown multiple layers of:

a. Silicon;

b. Germanium; or

c. III/V compounds of gallium or indium;

Technical Note: III/V compounds are polycrystalline or binary or complex monocrystalline products consisting of elements of groups IIIA and VA of Mendeleyev's periodic classification table (gallium arsenide, gallium-aluminium arsenide, indium phosphide, etc.).

1033.2. Resist materials, as follows, and "substrates" coated with embargoed resists:

a. Positive resists with a spectral response optimized for use below 370 nm;

b. All resists, for use with electron beams or ion beams, with a sensitivity of 0.01 microcoulomb/mm^2 or better;

c. All resists, for use with X-rays, with a sensitivity of 2.5 mJ/mm² or better;

d. All resists optimized for surface imaging technologies, including silyated resists;

Technical Note: Silyation techniques are defined as processes incorporating oxidation of the resist surface to enhance performance for both wet and dry developing.

1033.3. Metal-organic compounds of aluminium, gallium or indium, having a purity (metal basis) better than 99.999%;

1033.4. Hydrides of phosphorus, arsenic or antimony, having a purity better than 99.999%, even diluted in neutral gases;

NOTE:
1033.4. does not embargo hydrides containing 20% molar or more of rare gases or hydrogen.

1034. Software

1034. 1. "Software" specially designed for the "development" or "production" of equipment embargoed by 1031.1.b. to 1031.2.h. or 1032.;

2. "Software" specially designed for the "use" of "stored programme controlled" equipment embargoed by 1032.;

3. Computer-aided-design (CAD) "software" for semiconductor devices or integrated circuits, having any of the following:

a. Design rules or circuit verification rules;
b. Simulation of the physically laid out circuits; or
c. Lithographic processing simulators for design;

Technical Note:
A lithographic processing simulator is a "software" package used in the design phase to define the sequence of lithographic, etching and deposition steps for translating masking patterns into specific topographical patterns in conductors, dielectrics or semiconductor material.

NOTE:
1034.3. does not embargo "software" specially designed for schematic entry, logic simulation, placing and routing, layout verification or pattern generation tape;

N.B.:Libraries, design attributes or associated data for the design of semiconductor devices or integrated circuits are considered as technology.

1035. Technology

1035. 1. Technology according to the General Technology Note for the "development" or "production" of equipment or materials embargoed by 1031., 1032. or 1033.;

NOTE:
1035.1.does not embargo technology for the "development" or "production" of:

a. Microwave transistors operating at frequencies below 31 GHz;

b. Integrated circuits embargoed by 1031.1.a.3. to 11., having both of the following characteristics:

  1. Using technology of one micrometre or more, and

  2. Not incorporating multi-layer structures.

N.B.: This Note does not preclude the export of multilayer technology for devices incorporating a maximum of two metal layers and two polysilicon layers.

1035.2. Other technology for the "development" or "production" of:

a. Vacuum microelectronic devices;

b. Hetero-structure semiconductor devices such as high electron mobility transistors (HEMT), hetero-bipolar transistors (HBT), quantum well or super lattice devices;

c. "Superconductive" electronic devices;

1040. COMPUTERS

NOTES:
1. Computers, related equipment or "software" performing telecommunications or "local area network" functions must also be evaluated against the performance characteristics of Category 1050 (Telecommunications).

2. Computers, related equipment or "software" performing cryptographic, cryptanalytic, certifiable multi-level security or certifiable user isolation functions, or which limit electromagnetic compatibility (EMC), must also be evaluated against the performance characteristics in Category 1150 ("Information Security").

N.B.:

1. Control units which directly interconnect the buses or channels of central processing units, "main storage" or disk controllers are not regarded as telecommunications equipment described in Category 1050 (Telecommunications).
2. For the embargo status of "software" which provides routing or switching of "datagram" or "fast select" packets (i.e., packet by packet route selection) or of "software" specially designed for packet switching, see Category 1050 (Telecommunications).

1041. Equipment, Assemblies and Components

1041. 1. Electronic computers and related equipment, as follows, and "assemblies" and specially designed components therefor:

a. Specially designed to have either of the following characteristics:

1. Rated for operation at an ambient temperature below 228 K (-45° C) or above 343 K (70° C); or

NOTE:
1041.1.a.1. does not apply to computers specially designed for civil automobile or railway engine applications.

2. Radiation-hardened to exceed any of the following specifications:

a. Total Dose 5×10^{5} Rads (Si)

b. Dose Rate Upset 5×10^{8} Rads (Si)/sec; or

c. Single Event Upset 1×10^{-7} Error/bit/day;

NOTE: Equipment designed or rated for transient ionising radiation is embargoed by the Munitions List.

b. Having characteristics or performing functions exceeding the limits in Category 1150 ("Information Security");

1041. 2. "Hybrid computers", as follows, and "assemblies" and specially designed components therefor:

a. Containing "digital computers" embargoed by 1041.3.;

b. Containing analogue-to-digital or digital-to-analogue converters having both of the following characteristics:

1. 32 channels or more; and

2. A resolution of 14 bits (plus sign bit) or more with a conversion rate of 200,000 conversions/s or more;

1041. 3. "Digital computers", "assemblies", and related equipment therefor, as follows, and specially designed components therefor:

NOTES:

1. 1041.3. includes vector processors, array processors, logic processors, and equipment for "image enhancement" or "signal processing".

2. The embargo status of the "digital computers" or related equipment described in 1041.3 is governed by the embargo status of other equipment or systems provided:

   a. The "digital computers" or related equipment are essential for the operation of the other equipment or systems;

   b. The "digital computers" or related equipment are not a "principal element" of the other equipment or systems; and

N.B.:

1. The embargo status of "signal processing" or "image enhancement" equipment described in 1041.3.g. and specially designed for other equipment with functions limited to those required for the other equipment is determined by the embargo status of the other equipment even if it exceeds the "principal element" criterion.

2. For the embargo status of "digital computers" or related equipment for telecommunications equipment, see Category 1050 (Telecommunications).

c. The technology for the "digital computers" and related equipment is governed by 1045.

3. "Digital computers" or related equipment are not embargoed by 1041.3 provided:

a. They are essential for medical applications;

b. The equipment is substantially restricted to medical applications by nature of its design and performance;

c. The equipment does not have "user-accessible programmability" other than that allowing for insertion of the original or modified "programmes" supplied by the original manufacturer;

d. The "composite theoretical performance" of any "digital computer" which is not designed or modified but essential for the medical application does not exceed 20 million theoretical operations per second (Mtops); and

e. The technology for the "digital computers" or related equipment is governed by 1045.

1041. 3. a. Designed for combined recognition, understanding and interpretation of image or continuous (connected) speech;

1041.3. b. Designed or modified for "fault tolerance";

NOTE:
For the purposes of 1041.3.b., "digital computers" and related equipment are not considered to be designed or modified for "fault tolerance", if they use:

1. Error detection or correction algorithms in "main storage";

2. The interconnection of two "digital computers" so that, if the active central processing unit fails, an idling but mirroring central processing unit can continue the system's functioning;

3. The interconnection of two central processing units by data channels or by use of shared storage to permit one central processing unit to perform other work until the second central processing unit fails, at which time the first central processing unit takes over in order to continue the system's functioning; or

4. The synchronisation of two central processing units by "software" so that one central processing unit recognises when the other central processing unit fails and recovers tasks from the failing unit.

1041.3. c. "Digital computers" having a "composite theoretical performance" (CTP) exceeding 12.5 million theoretical operations per second (Mtops);

1041.3. d. "Assemblies" specially designed or modified to enhance performance by aggregation of "computing elements", as follows:

NOTES:

1. 1041.3.d. applies only to "assemblies" and programmable interconnections not exceeding the limit in 1041.3.c., when shipped as un-integrated "assemblies". It does not apply to "assemblies" inherently limited by nature of their design for use as related equipment embargoed by 1041.3.e. to k.

2. 1041.3.d. does not embargo "assemblies" specially designed for a product or family of products whose maximum configuration does not exceed the limit of 1041.3.c.

1. Designed to be capable of aggregation in configurations of 16 or more "computing elements"; or

2. Having a sum of maximum data rates on all data channels available for connection to associated processors exceeding 40 MBytes/s;

1041.3. e. Disk drives and solid state storage equipment, as follows:

1. Magnetic, erasable optical or magneto-optical disk drives with a "maximum bit transfer rate" exceeding 25 Mbit/s;

2. Solid state storage equipment, other than "main storage" (also known as solid state disks or RAM disks), with a "maximum bit transfer rate" exceeding 36 Mbit/s;

1041.3. f. Input/output control units designed for use with equipment embargoed by 1041.3.e.;

1041.3. g. Equipment for "signal processing" or "image enhancement" having a "composite theoretical performance" exceeding 8.5 million theoretical operations per second (Mtops);

1041.3. h. Graphics accelerators or graphics coprocessors exceeding a "3-D Vector Rate" of 400,000 or, if supported by 2-D vectors only, a "2-D vector rate" of 600,000;

NOTE:

1041.3.h. does not apply to work stations designed for and limited to:

1. Graphic arts (e.g., printing, publishing); and

2. The display of two-dimensional vectors.

1041.3. i. Colour displays or monitors having more than 12 resolvable elements per mm in the direction of the maximum pixel density;

NOTES:

1. 1041.3.i. does not embargo displays or monitors not specially designed for electronic computers.

2. Displays specially designed for Air Traffic Control (ATC) systems are treated as specially designed components for ATC systems under Category 1060.

1041.3. j. Equipment performing analogue-to-digital or digital-to-analogue conversions exceeding the limits in 1031.1.a.5.;

1041.3. k. Equipment containing "terminal interface equipment" exceeding the limits in 1051.b.3.;

NOTE:

For the purposes of 1041.3.k., "terminal interface equipment" includes "local area network" interfaces, modems and other communications interfaces. "Local area network" interfaces are evaluated as "network access controllers".

1041. 4. Computers, as follows, and specially designed related equipment, "assemblies" and components therefor:

a. "Systolic array computers";

b. "Neural computers";

c. "Optical computers";

1042. Test, Inspection and Production Equipment

1042. Equipment for the development and production of magnetic and optical storage equipment, as follows:

1. Equipment specially designed for the application of magnetic coating to embargoed non-flexible (rigid) magnetic or magneto-optical media;

NOTE:

1042.1.does not embargo general purpose "sputtering" equipment.

2. "Stored programme controlled" equipment specially designed for monitoring, grading, exercising or testing embargoed rigid magnetic media;

3. Equipment specially designed for the production or alignment of heads or head/disk assemblies for embargoed rigid magnetic and magneto-optical storage, and electro-mechanical or optical components therefor;

1043. Materials

Materials specially formulated for and required for the fabrication of head/disk assemblies for embargoed magnetic and magneto-optical hard disk drives;

1044. Software

NOTE:
The embargo status of "software" for the "development", "production", or "use" of equipment described in other Categories is dealt with in the appropriate Category. The embargo status of "software" for equipment described in this Category is dealt with herein.

1044. 1. "Software" specially designed or modified for the "development", "production" or "use" of equipment, materials or "software" embargoed by 1041.,1042., 1043. or 1044.;

1044. 2. "Software" specially designed or modified to support "technology" embargoed by 1045.

1044. 3. Specific "software", as follows:

a. "Programme" proof and validation "software" using mathematical and analytical techniques and designed or modified for "programmes" having more than 500,000 "source code" instructions;

b. "Software" allowing the automatic generation of "source codes" from data acquired on line from external sensors described in these Lists;

c. Operating system "software", "software" development tools and compilers specially designed for "multi-data-stream processing" equipment, in "source code";

d. "Expert systems" or "software" for "expert system" inference engines providing both:

1. Time dependent rules; and

2. Primitives to handle the time characteristics of the rules and the facts;

e. "Software" having characteristics or performing functions exceeding the limits in Category 1150 ("Information Security");

f. Operating systems specially designed for "real time processing" equipment which guarantees a "global interrupt latency time" of less than 30 microseconds;

1045. Technology

1045. 1. "Technology" according to the General Technology Note, for the "development", "production" or "use" of equipment, materials or "software" embargoed by 1041., 1042.,1043 or 1044.

1045. 2. a. "Technology" for the "development" or "production" of equipment released under 1041.3.h.;

b. "Technology" for the "development" or "production" of equipment designed for "multi-data-stream processing";

c. Technology "required" for the "development" or "production" of magnetic hard disk drives with a "maximum bit transfer rate" exceeding 11 Mbit/s.

NOTES:

1. Governments may permit, as administrative exceptions, the shipment of "digital computers" embargoed by 1041.3.c.,or specially designed components therefor, and "software" embargoed by 1044.1., provided:

   a. They will be operated by civil end-users for civil applications;

   b. They have been primarily designed and used for non-strategic applications;

   c. The "CTP" of the "digital computers" does not exceed 20 Mtops;

   d. They do not contain any embargoed related equipment;

   e. When exported as enhancements, the enhanced "digital computer" does not exceed the limit in Note 1.c.;

   f. They are not shipped as enhancements to computers designed within a proscribed country;

   N.B.:
   This does not preclude the enhancement of such computers when they are used by civil end-users in civil applications.

   g. Any embargoed "software" is the minimum required for the "use" of the approved "digital computers";

   h. The Government of the exporting country shall:

      1. Be reasonably satisfied that:

a. The equipment will be used primarily for the specific non-strategic application for which the export would be approved; and

b. The equipment will not be used for the design, development or production of embargoed products;

2. Promptly report monthly the export to the Committee, in the regular monthly statistical returns, identifying specifically the equipment to be provided, the end-user with his full name and address and the end-use of the equipment; and

3. Promptly report to the Committee any evidence of the removal or diversion of the equipment from authorised purposes related to the specific export licence.

2. Governments may permit, as administrative exceptions, the shipment of equipment embargoed by 1041.3.e. or f. provided:

a. The "maximum bit transfer rate" does not exceed 36 Mbit/s;

b. They are exported as part of a computer system or as an enhancement to a previously exported system;

c. The Government of the exporting country shall notify the Committee 30 days prior to the proposed export; and

d. The Government of the exporting country shall:

1. Be reasonably satisfied that:

a. The equipment will be used primarily for the specific non-strategic application for which the export would be approved; and

b. The equipment will not be used for the design, development or production of embargoed products;

2. Promptly report monthly the export to the Committee, in the monthly statistical returns, identifying specifically the equipment to be provided, the end-user with his full name and address and the end-use of the equipment; and

3. Promptly report to the Committee any evidence of the removal or diversion of the equipment from authorised purposes related to the specific export licence.

3. The Committee will favourably consider the export of "digital computers" or related equipment therefor embargoed by 1041.3.c., e., f. or g., or "software" embargoed by 1044.1., provided:

   a. They will be operated by civil end-users for civil applications;

   b. They have been primarily designed and used for non-strategic applications;

   c. They do not exceed any of the following limits:

      1. CTP of the "digital computers" - 23 Mtops;

      2. "Maximum bit transfer rate" of disk drives or input/output control units embargoed by 1041.3.e. or f. - 36 Mbit/s; or

      3. CTP of "signal processing" or "image enhancement" equipment - 12.5 Mtops;

   d. They do not contain any other embargoed related equipment;

   e. When exported as enhancements, the enhanced "digital computer" does not exceed the limit in Note 3.c.;

   f. They are not shipped as enhancements to computers designed within a proscribed area;

   g. Any embargoed "software" is the minimum required for the "use" of the approved "digital computers" and related equipment;

   h. Governments administer this Note as follows:

      1. The requesting Government will in all cases provide the Committee with information which includes:

         a. A signed statement by a responsible representative of the end-user(s) or the importing agency describing the end-use and certifying that:

            1. The "digital computers" or related equipment will:

               a. Be used only for civil applications; and

b. Not be reexported or otherwise disposed of without permission from the Government of the exporting country;

2. Responsible Western representatives of the supplier will:

a. Have the right of access to the "computer using facility" and all equipment, wherever located, during normal working hours and at any other time the equipment is operating; and

b. Be furnished information demonstrating continued authorised application of the equipment; and

c. These Western representatives will be notified of any significant change of application or of other facts, on which the licence was based;

b. A full description of:

1. The equipment; and

2. Its intended application and workload; and

c. A complete identification of all end-users and their activities;

2. The requesting Government will in all cases:

a. Promptly report to the Committee evidence of:

1. Any violation of the conditions of this Note; or

2. Any removal or diversion of the equipment from authorised purposes, related to the specific export licence; and

b. In such cases, immediately terminate to the extent possible and in accordance with their legislation, all further shipments of equipment and spare parts, technology and "software" therefor by the supplier to the specified end-user(s);

i. The Committee will:

1. Approve the export of equipment described in this Note if no member country has filed an objection within four weeks of the receipt of complete information on the case; and

2. Consider, when assessing proposed exports and the comments of member countries on such proposed exports:
   a. The appropriateness of the equipment to the stated end-use;

   b. Any evidence which would indicate that the proposed end-users are:

      1. Directly involved in significant strategic, including intelligence, activities; or

      2. Affiliated with organisations that foster diversion to strategic purposes;

   c. The extent to which the equipment will support the strategic activities of the end-users; and

   d. The extent to which diversion would disrupt the activities of the proposed end-users

1040. Technical Note:

"COMPOSITE THEORETICAL PERFORMANCE" (CTP)

Abbreviations used in this Technical Note

CE	"computing element" (typically an arithmetic logical unit)
FP	floating point
XP	fixed point
t	execution time
XOR	exclusive OR
CPU	central processing unit
TP	theoretical performance (of a single CE)
CTP	"composite theoretical performance" (multiple CEs)
R	effective calculating rate Execution time 't' is expressed in microseconds, and CTP is expressed in Mtops (millions of theoretical operations per second).

CTP is a measure of computational performance given in millions of theoretical operations per second (Mtops). In calculating the "Composite Theoretical Performance" (CTP) of a configuration of Computing Elements (CEs) the following three steps are required:

1. Calculate the effective calculating rate R for each CE;
2. Apply the word length adjustment to this rate, resulting in a Theoretical Performance (TP) for each CE. Select the maximum resulting value of TP;

3. If there is more than one "computing element", combine the TPs resulting in a "Composite Theoretical Performance" for the configuration.

   NOTE:
   This aggregation should not be applied to computers connected through a decontrolled "local area network".

4. Technical Note:
   "COMPOSITE THEORETICAL PERFORMANCE" (CTP) The following table shows the method of calculating the Effective Calculating Rate R for each Computing Element:

For Computing Element's (CE'S) Implementing:	Effective calculating Rate, R
XP only (Rxp)	$\frac{1}{(3\times t_{xp\ add})}$ if no add is implemented use: $\frac{1}{(3\times t_{xp\ add})}$ If neither add nor multiply is implemented use the fastest available arithmetic operation as follows: $\frac{1}{(3\times t_{xp\ add})}$ See Notes X & Z
FP only	$\max\frac{1}{t_{fp\ add}}, \frac{1}{t_{fp\ mult}}$ See notes X & Z
Both FP and XP	Calculate both Rxp, Rfp
For simple logic processors not implementing any of the specified arithmetic operations.	$\frac{1}{3\times t_{log}}$ Where tlog is the execution time of the XOR, or for logic hardware not implementing the XOR, the fastest simple logic operation. See Notes X & Z

For special logic processors not using any of the specified arithmetic or logic operations.	R = R′ * WL/64 where R′ is the number of results per second, WL is the number of bits upon which the logic operation occurs, and 64 is a factor to normalize to a 64 bit operation.

1040. Technical Note:

"COMPOSITE THEORETICAL PERFORMANCE" (CTP) (con't)

Note X: For CEs which perform multiple arithmetic operations of a specific type in a single cycle (e.g., two additions per cycle), the execution time t is given by:

$$t = \frac{\text{cycle time}}{\text{the number of arithmetic operations per machine cycle}}$$

CEs which perform different types of arithmetic operations in a single machine cycle are to be treated as multiple separate CEs performing simultaneously (e.g., a CE performing an addition and a multiplication in one cycle is to be treated as two CEs, the first performing an addition in one cycle and the second performing a multiplication in one cycle). If a single CE has both scalar function and vector function, use larger value.

Note Y: If no FP add or FP multiply are implemented, but the CE performs FP divide:

$$R_{fp} = \frac{1}{t_{fp\ divide}}$$

If the divide is not implemented, the fp reciprocal should be used. If none of the specified instructions is implemented, the effective FP rate is 0.

Note Z: In simple logic operations, a single instruction performs a single logic manipulation of no more than two operands of given lengths. In complex logic operations, a single instruction performs multiple logic manipulations to produce one or more results from two or more operands. Rates should be calculated for all supported operand lengths, using the fastest executing instruction for each operand length based on:

1. Register-to-register. Exclude extraordinarily short execution times generated for operations on a predetermined operand or operands (for example, multiplication by 0 or 1). If no register-register operations are implemented, continue with (2).

2. The faster of register-to-memory or memory-to-register operations; if these also do not exist, then continue with (3).

3. Memory-to-memory.

In each case above, use the shortest execution time certified by the manufacturer.

1050. TELECOMMUNICATIONS

NOTES:

A. The embargo status of components, "lasers", test and production equipment, materials and "software" therefor which are specially designed for telecommunications equipment or systems is defined in this Category.

B. "Digital computers", related equipment or "software", when essential for the operation and support of telecommunications equipment described in this Category, are regarded as specially designed components, provided they are the standard models customarily supplied by the manufacturer. This includes operation, administration, maintenance, engineering or billing computer systems.

1051. Equipment, Assemblies and Components

1051. a. Any type of telecommunications equipment having any of the following characteristics, functions or features:

1. Specially designed to withstand transitory electronic effects or electromagnetic pulse arising from a nuclear explosion;

2. Specially hardened to withstand gamma, neutron or ion radiation;

3. Specially designed to operate outside the temperature range from 219 K (-54° C) to 397 K (124° C);

NOTE:
1051.a.3. applies only to electronic equipment.

NOTE:
1051.a.2. and 3. do not apply to equipment on board satellites.

1051. b. "Telecommunication transmission equipment" or systems, and specially designed components and accessories therefor, having any of the following characteristics, functions or features:

NOTE:
"Telecommunication transmission equipment"

a. Categorised as follows, or combinations thereof:

1. Radio equipment (e.g., transmitters, receivers and transceivers);
2. Line terminating equipment;
3. Intermediate amplifier equipment;
4. Repeater equipment;
5. Regenerator equipment;
6. Translation encoders (transcoders);
7. Multiplex equipment (statistical mutiplex included);
8. Modulators/ demodulators (modems);
9. Transmultiplex equipment (see CCITT Rec. G701);
10. "Stored programme controlled" digital cross-connection equipment;
11. "Gateways" and bridges;
12. "Media access units; and

b. Designed for use in single or multi-channel communication via:

1. Wire (line);
2. Coaxial cable;
3. Optical fibre cable;
4. Electromagnetic radiation.

1051. b. 1. Employing digital techniques, including digital processing of analogue signals, and designed to operate at a "digital transfer rate" at the highest multiplex level exceeding 45 Mbit/s or a "total digital transfer rate" exceeding 90 Mbit/s;

NOTE:
1051.b.1. does not embargo equipment specially designed to be integrated and operated in any satellite system for civil use.

1051. b. 2. Being "stored programme controlled" digital cross connect equipment with a "digital transfer rate" exceeding 8.5 Mbit/s per port;

1051. b. 3. Being equipment containing:

a. Modems using the "bandwidth of one voice channel" with a "data signalling rate" exceeding 9,600 bit/s;

b. "Communication channel controllers" with a digital output having a "data signalling rate" exceeding 64,000 bit/s per channel; or

c. "Network access controllers" and related common medium having a "digital transfer rate" exceeding 33 Mbit/s;

NOTE:
If any unembargoed equipment contains "network access controller", it cannot have any type of telecommunications interface except those described in, but not embargoed by, 1051.b.3.

1051. b. 4. Employing a "laser" and having any of the following characteristics:

a. A transmission wavelength exceeding 1,000 nm;

b. Employing analogue techniques and having a bandwidth exceeding 45 MHz;

c. Employing coherent optical transmission or coherent optical detection techniques (also called optical heterodyne or homodyne techniques);

d. Employing wavelength division multiplexing techniques; or

e. Performing "optical amplification";

1051. b. 5. Being radio equipment operating at input or output frequencies exceeding:

a. 31 GHz for satellite-earth station applications;

b. 26.5 GHz for other applications;

NOTE:
1051.b.5.b.does not embargo equipment for civil use conforming with an ITU allocated band between 26.5 and 31 GHz.

1051. b. 6. Being radio equipment:

a. Employing quadrature-amplitude-modulation (QAM) techniques above level 4; or

b. Employing other digital modulation techniques and having a "spectral efficiency" exceeding bit/sec/Hz;

NOTE:
1051.b.6.b. does not embargo equipment specially designed to be integrated and operated in any satellite system for civil use.

1051. b. 7. Being radio transmitting equipment operating in the 1.5 to 87.5 MHz band and having either of the following characteristics:

a. 1. Automatically predicting and selecting frequencies and "total digital transfer rates" per channel to optimize the transmission; and

2. Incorporating a linear power amplifier configuration having a capability to support multiple signals simultaneously at an output power of 1 kW or more in the 1.5 to 30 MHz frequency range or 250 W or more in the 30 to 87.5 MHz frequency range, over an "instantaneous bandwidth" of one octave or more and with an output harmonic and distortion content of better than -80 dB; or

b. Incorporating adaptive techniques providing more than 15 dB suppression of an interfering signal;

1051. b. 8. Being radio equipment employing "spread spectrum" or "frequency agility" (frequency hopping) techniques having either of the following characteristics:

a. User programmable spreading codes; or

b. A total transmitted bandwidth which is 100 or more times the bandwidth of any one information channel and in excess of 50 kHz;

1051. b. 9. Being digitally controlled radio receivers having more than 1,000 channels, which:

a. Search or scan automatically a part of the electromagnetic spectrum;

b. Identify the received signals or the type of transmitter; and

c. Have a "frequency switching time" of less than 1 ms;

1051. b. 10. Providing functions of digital "signal processing" as follows:

a. Voice coding at rates of less than 2,400 bit/s;

b. Employing circuitry which incorporates "user-accessible programmability" of digital "signal processing" circuits exceeding the limits of 1041.3.g.;

1051. b. 11. Being underwater communications systems having any of the following characteristics:

a. An acoustic carrier frequency outside the range from 20 to 60 kHz;

b. Using an electromagnetic carrier frequency below 30 kHz; or

c. Using electronic beam steering techniques;

1051. c. "Stored programme controlled" switching equipment and related signalling systems, having any of the following characteristics, functions or features; and specially designed components and accessories therefor:

NOTE:
Statistical multiplexers with digital input and digital output which provide switching are treated as "stored programme controlled" switches.

1051. c. 1. "Common channel signalling";

NOTE:
Signalling systems in which the signalling channel is carried in and refers to no more than 32 multiplexed channels forming a trunk line of no more than 2.1 Mbit/s, and in which the signalling information is carried in a fixed, time division multiplexed channel without the use of labelled messages, are not considered to be "common channel signalling" systems.

1051. c. 2. Containing "Integrated Services Digital Network" (ISDN) functions and having either of the following:

a. Switch-terminal (e.g., subscriber line) interfaces with a "digital transfer rate" at the highest multiplex level exceeding 192,000 bit/s, including the associated signalling channel (e.g., 2B+D); or

b. The capability that a signalling message received by a switch on a given channel that is related to a communication on another channel may be passed through to another switch;

NOTE:
1051.c.2. does not preclude:

1. The evaluation and appropriate actions taken by the receiving switch;

2. Unrelated user message traffic on a D channel of ISDN.

1051. c. 3. Multi-level priority and pre-emption for circuit switching;
NOTE:
1051.c.3. does not embargo single-level call pre-emption.

1051. c. 4. "Dynamic adaptive routing";

1051. c. 5. Routing or switching of "datagram" packets;

1051. c. 6. Routing or switching of "fast select" packets;

NOTE:
The restrictions in 1051.c.5. and 6. do not apply to networks using only "network access controllers" or to "network access controllers" themselves.

1051. c. 7. Designed for automatic hand-off of cellular radio calls to other cellular switches or for automatic connection to a centralized subscriber data base common to more than one switch;

1051. c. 8. Being packet switches, circuit switches and routers with ports or lines exceeding either:

a. A "data signalling rate" of 64,000 bit/s per channel for a "communications channel controller"; or

NOTE:
1051.c.8.a. does not preclude the multiplexing over a composite link of communications channels not embargoed by 1051.c.8.a.

b. A "digital transfer rate" of 33 Mbit/s for a "network access controller" and related common medium;

1051. c. 9. "Optical switching";

1051. c. 10. Employing "Asynchronous Transfer Mode" (ATM) techniques;

11. Containing "stored programme controlled" digital crossconnect equipment with a "digital transfer rate" exceeding 8.5 Mbit/s per port;

1051. d. Centralized network control having both of the following characteristics:

1. Receives data from the nodes; and

2. Processes these data in order to provide control of traffic not requiring operator decisions, thereby performing "dynamic adaptive routing";

NOTE:
1051.d. does not preclude control of traffic as a function of predictable statistical traffic conditions.

1051. e. Optical fibre communication cables, optical fibres and specially designed components and accessories therefor, as follows:

1. Optical fibres or cables of more than 50 m in length having either of the following characteristics:

a. Designed for single mode operation; or

b. For optical fibres, capable of withstanding a "proof test" tensile stress of 2×10^9 N/m2 or more;

Technical Note:
"Proof Test" On-line or off-line production screen testing that dynamically applies a prescribed tensile stress over a 0.5 to 3 m length of fibre at a running rate of 2 to 5 m/s while passing between capstans approximately 15 cm in diameter. The ambient temperature is a nominal 293 K and relative humidity 40%.

N.B.: Equivalent national standards may be used for executing the "proof test".

1051. e. 2. Components and accessories specially designed for the optical fibres or cables embargoed by 1051.e.1., except connectors for use with optical fibres or cables with a repeatable coupling loss of 0.5 dB or more;

1051. e. 3. Optical fibre cables and accessories designed for underwater use; (For fibre-optic hull penetrators or connectors, see 1081.2.c.)

1051. f. Phased array antennae, operating above 10.5 GHz, containing active elements and distributed components, and designed to permit electronic control of beam shaping and pointing, except those for landing systems with instruments meeting ICAO standards (microwave landing systems (MLS));

1052. Test, Inspection and Production Equipment

1052. a. Equipment specially designed for:

1. Development of equipment, materials, functions or features embargoed by 1051., 1052., 1053., 1054. or 1055., including measuring or test equipment;

2. Production of equipment, materials, functions or features embargoed by 1051., 1052., 1053., 1054. or 1055., including measuring, test or repair equipment;

3. Use of equipment, materials, functions or features exceeding any of the least stringent embargo criteria applicable in 1051., 1052., 1053., 1054. or 1055., including measuring, repair or test equipment;

1052. b. Other equipment as follows:

1. Bit error rate (BER) test equipment designed or modified to test the equipment embargoed in 1051.b.1.;

2. Data communication protocol analyzers, testers and simulators for functions embargoed by 1051.b.1.;

3. Stand alone "stored programme controlled" radio transmission media simulators/channel estimators specially designed for testing equipment embargoed by 1051.b.5.

1053. Materials

Preforms of glass or of any other material optimized for the manufacture of optical fibres embargoed by 1051.e.;

1054. Software

1054. a. "Software" specially designed or modified for the development, production or use of equipment or materials embargoed by 1051., 1052 or 1053.;

b. "Software" specially designed or modified to support "technology" embargoed by 1055.;

c. Specific "software" as follows:

1. "Generic software", other than in machine-executable form, specially designed or modified for the "use" of "stored program controlled" digital switching equipment or systems;

2. "Software", other than in machine-executable form, specially designed or modified for the "use" of digital cellular radio equipment or systems;

3. "Software" specially designed or modified to provide characteristics, functions or features of equipment embargoed by 1051. or 1052.;

4. "Software" which provides capability of recovering "source code" of telecommunications "software" embargoed by this category;

5. "Software" specially designed for the "development" or "production" of "software" embargoed by 1054.; (For "software" for "signal processing" see also 1044. and 1064.)

1055. Technology

1055. a. Technology according to the General Technology Note for the "development", "production" or "use" (excluding operation) of equipment, systems, materials or "software" embargoed by 1051., 1052., 1053. or 1054.

b. Specific technologies as follows:

1. "Required" technology for the "development" or "production" of telecommunications equipment specially designed to be used on board satellites;

2. Technology for the "development" or "use" of laser communication techniques with the capability of automatically acquiring and tracking signals and maintaining communications through exoatmosphere or sub-surface (water) media;

3. Technology for processing and application of coatings to optical fiber specially designed to make it suitable for underwater use;

4. Technology for "development" or "production" of equipment employing "Synchronous Digital Hierarchy" (SDH) or "Synchronous Optical Network" (SONET) techniques;

5. Technology for the "development" or "production" of "switch fabric" exceeding 64,000 bits per second per information channel other than for digital cross connect integrated in the switch;

6. Technology for the "development" or "production" of centralized network control;

7. Technology for the "development" or "production" of digital cellular radio systems;

8. Technology for the "development" or "production" of "Integrated Services Digital Network" (ISDN).

NOTES:

1. Governments may permit, as administrative exceptions, the shipment of telecommunications equipment for optical fibres embargoed by 1051.b.4.a., provided the transmission wavelength does not exceed 1370 nm.

2. Governments may permit, as administrative exceptions, the shipment of cables or fibres embargoed by 1051.e. provided:

   a. Quantities are normal for the envisaged end-use; and

   b. They are for a specified civil end-use.

3. Governments may permit, as administrative exceptions, the shipment of optical fibre test equipment embargoed by 1052.a.3. using a transmission wavelength not exceeding 1370 nm.

4. Governments may permit, as administrative exceptions, the shipment to COCOM-agreed countries of equipment or systems embargoed by 1051.b., c., d., e. or f., and test equipment, "software" and "use" technology therefor, provided the Government of the exporting country:

   a. Is reasonably satisfied that the equipment or systems:

      1. Are designed for and will be used for specific civil applications; and

      2. Will be operated in the importing country by a civil end-user who has furnished to the supplier a signed statement certifying that the equipment or systems will be used only for the specific end-use;

   b. Notifies the Committee at the time of licensing the export under the provisions of this Note. The information to accompany each case will include:

      1. End-use assurances provided by the importer and backed by his national authorities;

      2. A full description of the equipment or systems to be provided;

      3. The installation site and intended application; and

   c. Promptly reports to the Committee evidence of:

      1. Any violation of the conditions of this Note; or

      2. Any removal or diversion of the equipment from authorized purposes related to the specific export licence.

5. Governments may permit, as administrative exceptions, the shipment of digital radio equipment or systems embargoed by 1051.b.1. or 1051.b.6. provided:

a. The equipment or system is intended for general commercial international traffic in an international civil telecommunication system, one end of which is in a COCOM member country;

b. It is to be installed in a permanent circuit under the supervision of the COCOM member country licensee;

c. No means are to be provided for the transmission of traffic between points in a single proscribed country other than a COCOM-agreed country;

d. The "digital transfer rate" at the highest multiplex level does not exceed 156 Mbit/s;

e. The equipment does not employ either of the following:

   1. Quadrature Amplitude Modulation (QAM) techniques above 64 QAM; or

   2. Other digital modulation techniques with a "spectral efficiency" exceeding 6 bit/s/Hz;

f. The equipment is not embargoed by 1051.b.5., 1051.b.8. or 1151.;

g. Spare parts shall remain under control of the COCOM member country licensee;

h. The COCOM member country licensee or his designated representative who shall be from a non-proscribed country shall have the right of access to all the equipment;

i. There will be no transfer of embargoed technology;

j. Systems installation, operation and maintenance shall be performed by the licensee or the licensee's designated representative, who shall be from a non-proscribed country, using only personnel from non-proscribed countries, until such time as the Committee agrees otherwise;

k. Upon request, the licensee shall carry out an inspection to establish that:

   1. The system is being used for the intended civil purpose; and

2. All the equipment exported under the provisions of this Note is being used for the stated end purpose and is still located at the installation sites;

After each inspection, the licensee shall report his findings to his authorities within one month. The Government of the exporting country must report any deviation from these conditions to the Committee;

1. Governments will notify the Committee 30 days in advance of issuing the licence.

6. Will be favourably considered the export of radio relay communications equipment, specially designed components and accessories, specially designed test equipment, "software" and technology for the "use" of equipment or materials therefor, embargoed by 1051., 1052., 1053., 1054. or 1055., provided:

a. It is for fixed installation and civil application;

b. It is designed for operation at a "digital transfer rate" not exceeding 156 Mbit/s;

c. The equipment does not employ either of the following:

   1. Quadrature Amplitude Modulation (QAM) techniques above 64 QAM; or

   2. Other digital modulation techniques with a "spectral efficiency" exceeding 6.3 bit/s/Hz;

d. It operates at fixed frequencies not exceeding 9 GHz;

e. When submitting export requests under the provisions of this Note, the Government of the exporting country will provide a statement identifying:

   1. The equipment or system to be provided;

   2. The intended application; and

   3. The location of the equipment.

f. The Committee will approve the case if no member country has raised an objection within four weeks of the receipt of complete information on the application.

7. Will be favourably considered the export of optical fibre cables and optical fibre transmission equipment or systems embargoed by 1051.b. or 1051.e., provided:

   a. The equipment or system is intended for general commercial international traffic in an international civil submarine optical fibre telecommunication system linking the importing country with a COCOM member country;

   b. It is to be installed in a permanent circuit under the supervision of the COCOM member country licensee;

   c. No means are to be provided for the transmission of traffic between points in one or more proscribed countries other than COCOM-agreed countries;

   d. The total length of optical fibre cable to be installed within the proscribed country, excluding cable in territorial waters, does not exceed 10 km or the shortest distance which is practical for installation;

   e. The "digital transfer rate" at the highest multiplex level does not exceed 565 Mbit/s;

   f. The "laser" transmission wavelength does not exceed 1550 nm;

   g. The equipment is not embargoed by 1051.b.4.b. to e. or 1054.2.;

   h. Spare parts shall remain under control of the COCOM member country licensee;

   i. The COCOM member country licensee or his designated representative, who shall be from a non-proscribed country, shall have the right of access to all the equipment;

   j. There will be no transfer of embargoed technology;

   k. Systems installation, operation and maintenance shall be performed by the licensee or the licensee's designated representative, who shall be from a non-proscribed country, using only personnel from non-proscribed countries, until such time as the Committee agrees otherwise;

   l. Upon request, the licensee shall carry out an inspection to establish that:

1. The system is being used for the intended civil purpose;

2. All the equipment exported under the provisions of this Note is being used for the stated end purpose and is still located at the installation sites.

After each inspection, the licensee shall report his findings to his authorities within one month. The Government of the exporting country must report any deviation from these conditions to the Committee.

m. Will be approved the case if no member country has raised an objection within four weeks of the receipt of complete information on the application.

8. Will be favourably considered the export of technology embargoed by this Category and of instrumentation, test equipment, components and specially designed "software" therefor, and materials end components embargoed by this Category or other Categories on this List, for modification or production of "stored programme controlled" circuit switching equipment or systems provided:

N.B.: Technology for general purpose computers is not eligible for treatment under this Note, i.e., it remains governed by Category 4;

a. The characteristics of the "stored programme controlled" circuit switching equipment or systems are limited to those which release them from embargo or make them eligible for treatment under relevant Administrative Exceptions Notes;

b. Modification of the "stored programme controlled" circuit switching equipment or systems is not permitted if any aspect of the design would result in exceeding the performance thresholds or features of the relevant Administrative Exception Notes;

c. Testing of large scale integrated (LSI) circuits or those with higher component densities is limited to go/no go tests;

N.B.: Sub-paragraph (c) above does not preclude exports of equipment or technology which would be possible according to the provisions of other Categories.

d. The specially designed "software" is that necessary to utilize the transferred technology, instrumentation and test equipment;

e. The manufacturing of the load tape by the licensee is limited to the addition to the generic "software" of the specific customer data and site parameters;

f. "Development" technology is not included;

g. The contract includes explicit conditions to ensure that:
    1. The "production" technology or "production" equipment is not re-re-exported or exported, either directly or indirectly, toanother proscribed destination;

    2. The supplier or licensor may appoint a representative who is entitled to verify that the "production" technology and "production" equipment or systems serve their intended use;

    3. Any modification of the capabilities or functions of the produced equipment must be approved by the supplier or licensor;

    4. The supplier's or licensor's personnel have right of access to all the facilities directly involved in the "production" of the "stored programme controlled" circuit switching equipment or systems;

    5. The "production" technology, "production" equipment and produced equipment or systems will be for civil end-use only;

h. System integration testing will be performed by the supplier or licensor, if it requires test tools which provide the licensee with the capability to recover source code or upgrade the system beyond the performance thresholds or features of the relevant Administrative Exceptions Notes;

i. The Committee shall approve the case if no member country has raised an objection within four (4) weeks of the receipt of complete information on the application;

N.B.: No export under the favourable consideration provisions of this Note shall establish a precedent for the approval of exports under other Categories in this List.

9. The Committee will favourably consider the export to COCOM-agreed countries of technology embargoed by this Category, and of instrumentation, test equipment, components and specially designed "software" therefor, and materials and components embargoed by this Category or other Categories on this List, for the modification or "production" of telecommunications equipment or systems eligible for treatment under Note 4, provided:

N.B.: Technology for general purpose computers is not eligible for treatment under this Note, i.e., it remains governed by Category 1040.

a. The characteristics of the telecommunications equipment or systems are limited to those eligible for treatment under Note 4;

b. Modification of the telecommunications equipment or systems is not permitted if any aspect of the design would result in exceeding the performance thresholds or features of Note 4;

c. Testing of large scale integrated (LSI) circuits or those with higher component densities is limited to go/no go tests;

N.B.: This sub-paragraph does not preclude exports of equipment or technology which would be possible according to the provisions of other Categories.

d. The specially designed "software" is that necessary to utilize the transferred technology, instrumentation and test equipment;

e. All "software" shall be exported in machine executable form only;

f. "Development" technology is not included;

g. The contract includes explicit conditions to ensure that:

   1. The "production" technology or "production" equipment is not re-exported or exported, either directly or indirectly, to another proscribed destination;

   2. The supplier or licensor may appoint a representative who is entitled to verify that the "production" technology and "production" equipment or systems serve their intended use;

3. Any modification of the capabilities or functions of the produced equipment must be approved by the supplier or licensor;

4. The supplier's or licensor's personnel have right of access to all the facilities directly involved in the "production" of the telecommunications equipment or systems;

5. The "production" technology, "production" equipment and produced equipment or systems will be for civil end-use only and not for re-export to COCOM proscribed destinations other than COCOM agreed countries;

h. System integration testing will be performed by the supplier or licensor, if it requires test tools which would provide the licensee with the capability to recover source code or upgrade the system beyond the performance thresholds or features of Note 4;

i. End-use reporting of the installed telecommunication equipment or systems will be provided in accordance with the provisions of Note 4;

j. The Committee will approve the case if no member country has raised an objection within four (4) weeks of the receipt of complete information on the application;

N.B.:

1. No export under the favourable consideration provisions of this Note shall establish a precedent for the approval of exports under other Categories in this List.

2. For each licence granted under this Note, the Government of the exporting country will require that the importer:

   a. Provide end-use assurances backed by his national authorities;

   b. Make available information as requested by the exporting country; and

   c. Allow on-site inspection if requested by the exporting country.

1150. INFORMATION SECURITY

NOTE:
The embargo status of "information security" equipment, "software", systems, application specific "assemblies", modules, integrated circuits, components or functions is defined in this Category even if they are components or "assemblies" of other equipment.

1151. Equipment, Assemblies and Components

Systems, equipment, application specific "assemblies", modules or integrated circuits for "information security", as follows, and other specially designed components therefor:

1151. a. Designed or modified to use "cryptography" employing digital techniques to ensure "information security";

b. Designed or modified to perform cryptanalytic functions;

c. Designed or modified to use "cryptography" employing analogue techniques to ensure "information security", except:

1. Equipment using "fixed" band scrambling not exceeding 8 bands and in which the transpositions change not more frequently than once every second;

2. Equipment using "fixed" band scrambling exceeding 8 bands and in which the transpositions change not more frequently than once every ten seconds;

3. Equipment using "fixed" frequency inversion and in which the transpositions change not more frequently than once every second;

4. Facsimile equipment;

5. Restricted audience broadcast equipment;

6. Civil television equipment;

d. Designed or modified to suppress the compromising emanations of information-bearing signals;

NOTE:
1151.d. does not embargo equipment specially designed to suppress emanations for health or safety reasons.

e. Designed or modified to use cryptographic techniques to generate the spreading code for "spread spectrum" or the hopping code for "frequency agility" systems;

f. Designed or modified to provide certified or certifiable "multilevel security" or user isolation at a level exceeding Class B2 of the Trusted Computer System Evaluation Criteria (TCSEC) or equivalent;

g. Communications cable systems designed or modified using mechanical, electrical or electronic means to detect surreptitious intrusion;

1152. Test, Inspection and Production Equipment

1152. a. Equipment specially designed for:

1. The development of equipment or functions embargoed by 1151., 1152., 1054. or 1155., including measuring or test equipment;

2. The production of equipment or functions embargoed by 1151., 1152., 1154. or 1155., including measuring, test, repair or production equipment;

b. Measuring equipment specially designed to evaluate and validate the "information security" functions embargoed by 1151. or 1154.

1153. Materials

None.

1154. Software

1154. a. "Software" specially designed or modified for the "development", "production" or "use" of equipment or "software" embargoed by 1151., 1152. or 1154.;

b. "Software" specially designed or modified to support technology embargoed by 1155.;

c. Specific "software" as follows:

1. "Software" having the characteristics, or performing or simulating the functions of the equipment embargoed by 1151. or 1152.;

2. "Software" to certify "software" embargoed by 1154.c.1.;

3. "Software" designed or modified to protect against malicious computer damage, e.g., viruses;

1155. Technology

Technology according to the General Technology Note for the "development", "production" or "use" of equipment or "software" embargoed by 1151., 1152. or 1154.

NOTES:

1. 1151. does not embargo:

   a. Personalized smart cards" using "cryptography" restricted for use only in equipment or systems excluded from embargo under 1151.c.1. to 6., under Note 1.b. to e., or as described in Notes 3 and 4;

   b. Equipment containing "fixed" data compression or coding techniques;

   c. Receiving equipment for radio broadcast, pay television or similar restricted audience television of the consumer type, without digital encryption and where digital decryption is limited to the video, audio or management functions;

   d. Portable (personal) or mobile radiotelephones for civil use, e.g., for use with commercial civil cellular radiocommunications systems, containing encryption, when accompanying their users;

   e. Decryption functions specially designed to allow the execution of copy-protected "software", provided the decryption functions are not user-accessible.

2. 1150. does not embargo:

   a. "Software" "required" for the "use" of equipment excluded from embargo under Note 1;

   b. "Software" providing any of the functions of equipment excluded from embargo under Note 1.

3. Governments may permit, as administrative exceptions, the shipment to COCOM-agreed countries of cellular radio equipment or systems specially designed for cryptographic operation, provided any message traffic encryption capability within the scope of the embargo under this Category contained in such equipment or systems is irreversibly disabled.

N.B.: Provided message traffic encryption is not possible within such a system, the export of mobile or portable cellular radio subscriber equipment containing cryptographic capabilities is permitted under this Note.

4. Governments may permit, as administrative exceptions, the shipment of the following cryptographic equipment, provided they are reasonably satisfied that the equipment is intended for civil use:

   a. Access control equipment, such as automatic teller machines, self-service statement printers or point of sale terminals, which protects password or personal identification numbers (PIN) or similar data to prevent unauthorized access to facilities but does not allow for encryption of files or text, except as directly related to the password or PIN protection;

   b. Data authentication equipment which calculates a Message Authentication Code (MAC) or similar result to ensure no alteration of text has taken place, or to authenticate users, but does not allow for encryption of data, text or other media other than that needed for the authentication;

   c. Cryptographic equipment specially designed, developed or modified for use in machines for banking or money transactions, such as automatic teller machines, self-service statement printers, point of sale terminals, or equipment for the encryption of interbanking transactions, and intended for use only in such applications.

5. Governments may permit, as administrative exceptions, the shipment of the following cryptographic "software":
   a. "Software" "required" for the "use" of equipment eligible for Administrative Exceptions under Notes 3 and 4;

   b. "Software" providing any of the functions of equipment eligible for Administrative Exceptions under Notes 3 and 4.

1060. SENSORS AND LASERS

1061. Equipment, Assemblies and Components

1061. 1. Acoustics

a. Marine acoustic systems, equipment or specially designed components therefor, as follows:

   1. Active (transmitting or transmitting-and-receiving) systems, equipment or specially designed components therefor, as follows:

NOTE:
1061.1.a.1. does not embargo depth sounders operating vertically below the apparatus, not including a scanning function exceeding ±10°, and limited to measuring the depth of water, the distance of submerged or buried objects or fish finding.

1061. 1. a. 1. a. Wide-swath bathymetric survey systems for sea bed topographic mapping:

1. Designed:

   a. To take measurements at an angle exceeding 10° from the vertical; and

   b. To measure depths exceeding 600 m below the water surface; and

2. Designed:

   a. To incorporate multiple beams any of which is less than 2°; or

   b. To provide data accuracies of better than 0.5% of water depth across the swath averaged over the individual measurements within the swath;

1061. 1. a. 1. b. Object detection or location systems having any of the following:

1. A transmitting frequency below 10 kHz;

2. Sound pressure level exceeding 224 dB (reference 1 micropascal at 1 m) for equipment with an operating frequency in the band from 10 kHz to 24 kHz inclusive;

3. Sound pressure level exceeding 235 dB (reference 1 micropascal at 1 m) for equipment with an operating frequency in the band between 24 kHz and 30 kHz;

4. Forming beams of less than 1° on any axis and having an operating frequency of less than 100 kHz;

5. Designed to withstand pressure during normal operation at depths exceeding 1,000 m and having transducers:

   a. Dynamically compensated for pressure; or

   b. Incorporating other than lead zirconate titanate as the transduction element; or

6. Designed to measure distances to objects at ranges exceeding 5,120 m;

1061. 1. a. 1. c. Acoustic projectors, including transducers, incorporating piezoelectric, magnetostrictive, electrostrictive, electrodynamic or hydraulic elements operating individually or in a designed combination, having any of the following:

NOTE:
The embargo status of acoustic projectors, including transducers, specially designed for other equipment is determined by the embargo status of the other equipment.

1. An instantaneous radiated acoustic power density exceeding 0.01 mW/mm²/Hz for devices operating at frequencies below 10 kHz;

2. A continuously radiated acoustic power density exceeding 0.001 mW/mm²/Hz for devices operating at frequencies below 10 kHz;

Technical Note:
Acoustic power density is obtained by dividing the output acoustic power by the product of the area of the radiating surface and the frequency of operation.

3. Designed to withstand pressure during normal operation at depths exceeding 1,000 m; or

4. Side-lobe suppression exceeding 22 dB;

NOTE:
1061.1.a.1.c. does not embargo electronic sources which direct the sound vertically only, or mechanical (e.g., air gun or vapour-shock gun) or chemical (e.g., explosive) sources.

1061. 1. a. 1. d. Acoustic systems, equipment or specially designed components for determining the position of surface vessels or underwater vehicles designed:

NOTE:
1061.1.a.1.d. includes equipment using coherent "signal processing" between two or more beacons and the hydrophone unit carried by the surface vessel or underwater vehicle, or capable of automatically correcting speed-of-sound propagation errors for calculation of a point.

1. To operate at a range exceeding 1,000 m with a positioning accuracy of less than 10 m rms (root mean square) when measured at a range of 1,000 m; or

2. To withstand pressure at depths exceeding 1,000 m;

1061. 1. a. 2. Passive (receiving, whether or not related in normal application to separate active equipment) systems, equipment or specially designed components therefor, as follows:

a. Hydrophones (transducers) with any of the following characteristics:

1. Incorporating continuous flexible sensors or assemblies of discrete sensor elements with either a diameter or length less than 20 mm and with a separation between elements of less than 20 mm;

2. Having any of the following sensing elements:

a. Optical fibres;

b. Piezoelectric polymers; or

c. Flexible piezoelectric ceramic materials

3. Hydrophone sensitivity better than -180 dB at any depth with no acceleration compensation;

4. When designed to operate at depths not exceeding 35 m, hydrophone sensitivity better than -186 dB with acceleration compensation;

5. When designed for normal operation at depths exceeding 35 m, hydrophone sensitivity better than -192 dB with acceleration compensation;

6. When designed for normal operation at depths exceeding 100 m, hydrophone sensitivity better than -204 dB; or

7. Designed for operation at depths exceeding 1,000 m;

Technical Note:
Hydrophone sensitivity is defined as twenty times the logarithm to the base 10 of the ratio of rms output voltage to a 1 V rms reference, when the hydrophone sensor, without a pre-amplifier, is placed in a plane wave acoustic field with an rms pressure of 1 micropascal. For example, a hydrophone of -160 dB (reference 1 V per micropascal) would yield an output voltage of 10^{-8} V in such a field, while one of -180 dB sensitivity would yield only 10^{-9} V output. Thus, -160 dB is better than -180 dB.

1061. 1. a. 2. b. Towed acoustic hydrophone arrays with:

1. Hydrophone group spacing of less than 12.5 m;

2. Hydrophone group spacing of 12.5 m to less than 25 m and designed or able to be modified to operate at depths exceeding 35 m; or

Technical Note:
'Able to be modified' in 1061.1.a.2.b.2. means having provisions to allow a change of the wiring or interconnections to alter hydrophone group spacing or operating depth limits. These provisions are: spare wiring exceeding 10% of the number of wires, hydrophone group spacing adjustment blocks or internal depth limiting devices that are adjustable or that control more than one hydrophone group.

3. Hydrophone group spacing of 25 m or more and designed to operate at depths exceeding 100 m;

4. Heading sensors:

    a. Having an accuracy of better than ±0.5°;

    b. Incorporated within the array hosing and designed or able to be modified to operate at depths exceeding 35 m; or

Technical Note:
'Able to be modified'in 1061.1.a.2.b.4.b. means having an adjustable or removable depth sensing device.

    c. Mounted external to the array hosing and having a sensor unit capable of operating with 36° roll at depths exceeding 35 m;

5. Non-metallic strength members or longitudinally reinforced array hoses;

6. An assembled array of less than 40 mm in diameter;

7. Multiplexed hydrophone group signals; or

8. Hydrophone characteristics specified in 1061.1.a.2.a.;

1061. 1. a. 2. c. Processing equipment, specially designed for towed acoustic hydrophone arrays, with either of the following:

1. A Fast Fourier or other transform of 1024 or more complex points in less than 20 ms with no "user-accessible programmability"; or

2. Time or frequency domain processing and correlation, including spectral analysis, digital filtering and beamforming using Fast Fourier or other transforms or processes with "user accessible programmability";

1061. 1. b. Terrestrial geophones capable of conversion for use in marine systems, equipment or specially designed components embargoed by 1061.1.a.2.a.;

1061. 1. c. Correlation-velocity sonar log equipment designed to measure the horizontal speed of the equipment carrier relative to the sea bed at distances between the carrier and the sea bed exceeding 500 m;

1061. 2. Optical Sensors

a. Optical detectors, as follows:

NOTE:
1061.2.a. does not embargo germanium or silicon photodevices.

1. "Space-qualified" single-element or focal plane array (linear or two dimensional) elements having any of the following:

a. 1. A peak response at a wavelength shorter than 300 nm; and

2. A response of less than 0.1% relative to the peak response at a wavelength exceeding 400 nm;

b. 1. A peak response in the wavelength range exceeding 900 nm but not exceeding 1,200 nm; and

2. A response "time constant" of 95 ns or less; or

c. A peak response in the wavelength range exceeding 1,200 nm but not exceeding 30,000 nm;

1061. 2. a. 2. Image intensifier tubes and specially designed components therefor, as follows:

a. Image intensifier tubes having all of the following:

1. A peak response in the wavelength range exceeding 400 nm but not exceeding 1,050 nm;

2. A microchannel plate for electron image amplification with a hole pitch (centre-to-centre spacing) of less than 25 micrometres; and

3. a. An S-20, S-25 or multialkali photocathode; or
   b. A GaAs or GaInAs photocathode;

b. Specially designed components, as follows:

1. Fibre optic image inverters;

2. Microchannel plates having both of the following characteristics:

   a. 15,000 or more hollow tubes per plate; and
   b. Hole pitch (centre-to-centre spacing) of less than 25 micrometres;

3. GaAs or GaInAs photocathodes;

1061. 2. a. 3. Non-"space-qualified" linear or two dimensional focal plane arrays, having any of the following:

NOTES:

1. 1061.2.a.3. includes photoconductive arrays and photovoltaic arrays.

2. 1061.2.a.3.does not embargo silicon focal plane arrays, multi-element (not to exceed 16 elements) encapsulated photoconductive cells or pyroelectric detectors using any of the following:
   a. Lead sulphide;

   b. Triglycine sulphate and variants;

   c. Lead-lanthanum-zirconium titanate and variants;

   d. Lithium tantalate;

   e. Polyvinylidene fluoride and variants;

   f. Strontium barium niobate and variants; or

   g. Lead selenide.

1061. 2. a. 3. a. 1. Individual elements with a peak response within the wavelength range exceeding 900 nm but not exceeding 1,050 nm; and

2. A response "time constant" of less than 0.5 ns;

b. 1. Individual elements with a peak response in the wavelength range exceeding 1,050 nm but not exceeding 1,200 nm; and

2. A response "time constant" of 95 ns or less; or

c. Individual elements with a peak response in the wavelength range exceeding 1,200 nm but not exceeding 30,000 nm;

1061. 2. a. 4. Non-"space-qualified" single-element or non-focal-plane multi-element semiconductor photodiodes or phototransistors having both of the following:

a. A peak response at a wavelength exceeding 1,200 nm; and

b. A response "time constant" of 0.5 ns or less;

1061.2. b. "Multispectral imaging sensors" designed for remote sensing applications, having either of the following characteristics:

1. An Instantaneous-Field-Of-View (IFOV) of less than 200 microradians; or

2. Specified for operation in the wavelength range exceeding 400 nm but not exceeding 30,000 nm; and

a. Providing output imaging data in digital format; and

b. 1. "Space-qualified"; or

2. Designed for airborne operation and using other than silicon detectors;

1061.2. c. Direct view imaging equipment operating in the visible or infrared spectrum, incorporating either of the following:

1. Image intensifier tubes embargoed by 1061.2.a.2.; or
2. Focal plane arrays embargoed by 1061.2.a.3.;

Technical Note:
'Direct view' refers to imaging equipment, operating in the visible or infrared spectrum, that presents a visual image to a human observer without converting the image into an electronic signal for television display, and that cannot record or store the image photographically, electronically or by any other means.

NOTE:
1061.2.c. does not embargo the following equipment incorporating other than GaAs or GaInAs photocathodes:

a. Industrial or civilian intrusion alarm, traffic or industrial movement control or counting systems;

b. Medical equipment;

c. Industrial equipment used for inspection, sorting or analysis of the properties of materials;

d. Flame detectors for industrial furnaces;

e. Equipment specially designed for laboratory use.

1061.2. d. Special support components for optical sensors, as follows:

1. "Space-qualified" cryocoolers;

2. Non-"space-qualified" cryocoolers, as follows:

   a. Closed cycle with a specified Mean-Time-To-Failure (MTTF), or Mean-Time-Between-Failures (MTBF), exceeding 2,500 hours;
   b. Joule-Thomson (JT) self-regulating minicoolers for bore diameters of less than 8 mm;

3. Optical sensing fibres:

   a. Specially fabricated either compositionally or structurally, or modified by coating, to be acoustically, thermally, inertially, electromagnetically or nuclear radiation sensitive; or

   b. Modified structurally to have a "beat length" of less than 50 mm (high birefringence);

1061.3. Cameras

1061.3. a. Instrumentation cameras, as follows:

1. High-speed cinema recording cameras using any film format from 8 mm to 16 mm inclusive, in which the film is continuously advanced throughout the recording period, and that are capable of recording at framing rates exceeding 13,150 frames per second;

   NOTE:
   1061.3.a.1. does not embargo cinema recording cameras for normal civil purposes.

2. Mechanical high speed cameras, in which the film does not move, capable of recording at rates exceeding 1,000,000 frames per second for the full framing height of 35 mm film, or at proportionately higher rates for lesser frame heights, or at proportionately lower rates for greater frame heights;

3. Mechanical or electronic streak cameras with writing speeds exceeding 10 mm per microsecond;

4. Electronic framing cameras having a speed exceeding 1,000,000 frames per second;

5. Electronic cameras having:

   a. An electronic shutter speed (gating capability) of less than 1 microsecond per full frame; and

   b. A read out time allowing a framing rate of more than 125 full frames per second;

b. Imaging cameras, as follows:

NOTE:
1061.3.b. does not embargo television or video cameras specially designed for television broadcasting.

1. Video cameras incorporating solid state sensors, having any of the following:

   a. More than 4×10^6 "active pixels" per solid state array for monochrome (black and white) cameras;

b. More than 4 x 10^6 "active pixels" per solid state array for colour cameras incorporating three solid state arrays; or

c. More than 12 x 10^6 "active pixels" for solid state array colour cameras incorporating one solid state array;

2. Scanning cameras and scanning camera systems:

a. Incorporating linear detector arrays with more than 8,192 elements per array; and

b. Having mechanical scanning in one direction;

3. Incorporating image intensifiers embargoed by 1061.2.a.2.a.;

4. Incorporating focal plane arrays embargoed by 1061.2.a.3.;

(For cameras specially designed or modified for underwater use, see 1081.2.d. and 1081.2.e.)

1061.4. Optics

a. Optical mirrors (reflectors), as follows:

1. "Deformable mirrors" with either continuous or multi-element surfaces, and specially designed components therefor, capable of dynamically repositioning portions of the surface of the mirror at rates exceeding 100 Hz;

2. Lightweight monolithic mirrors with an average "equivalent density" of less than 30 kg/m² and a total weight exceeding 10 kg;

3. Lightweight "composite" or foam mirror structures with an average "equivalent density" of less than 30 kg/m² and a total weight exceeding 2 kg;

4. Beam steering mirrors more than 100 mm in diameter or length of major axis with a control bandwidth exceeding 100 Hz;

1061. 4. b. Optical components made from zinc selenide (ZnSe) or zinc sulphide (ZnS) with transmission in the wavelength range exceeding 3,000 nm but not exceeding 25,000 nm and either of the following:

1. Exceeding 100 cm^3 in volume; or
2. Exceeding 80 mm in diameter or length of major axis and 20 mm in thickness (depth);

1061. 4. c. "Space-qualified" components for optical systems, as follows:

1. Lightweighted to less than 20% "equivalent density" compared with a solid blank of the same aperture and thickness;
2. Substrates, substrates with surface coatings (single-layer or multi-layer, metallic or dielectric, conducting, semiconducting or insulating) or with protective films;
3. Segments or assemblies of mirrors designed to be assembled in space into an optical system with a collecting aperture equivalent to or larger than a single optic 1 metre in diameter;
4. Manufactured from "composite" materials having a coefficient of linear thermal expansion equal to or less than 5×10^{-6} in any coordinate direction;

1061. 4. d. Optical filters, as follows:

1. For wavelengths longer than 250 nm, comprised of multi-layer optical coatings and having either of the following:
    a. Bandwidths equal to or less than 1 nm Full Width Half Intensity (FWHI) and peak transmission of 90% or more; or
    b. Bandwidths equal to or less than 0.1 nm FWHI and peak transmission of 50% or more;

    NOTE:
    1061.4.d.1. does not embargo optical filters with fixed air gaps or Lyot-type filters.

2. For wavelengths longer than 250 nm, having all of the following:

a. Tunable over a spectral range of 500 nm or more;

b. Instantaneous optical bandpass of 1.25 nm or less;

c. Wavelength resettable within 0.1 ms to an accuracy of 1 nm or better within the tunable spectral range; and

3. Optical opacity switches (filters) with a field of view of 30° or wider and a response time equal to or less than 1 ns;

1061. 4. e. Optical control equipment, as follows:

1. Specially designed to maintain the surface figure or orientation of the "space-qualified" components embargoed by 1061.4.c.1. or 3.;

2. Having steering, tracking, stabilization or resonator alignment bandwidths equal to or more than 100 Hz and an accuracy of 10 microradians or less;

3. Gimbals having a maximum slew exceeding 5°, a bandwidth equal to or more than 100 Hz, and either of the following:

a. 1. Exceeding 0.15 m but not exceeding 1 m in diameter or major axis length;

2. Capable of angular accelerations exceeding 2 radians/s²; and

3. Having angular pointing errors equal to or less than 200 microradians; or

b. 1. Exceeding 1 m in diameter or major axis length;

2. Capable of angular accelerations exceeding 0.5 radian/s²; and

3. Having angular pointing errors equal to or less than 200 microradians;

4. Specially designed to maintain the alignment of phased array or phased segment mirror systems consisting of mirrors with a segment diameter or major axis length of 1 m or more;

1061. 4. f. "Fluoride fibre" cable, or optical fibres therefor, having an attenuation of less than 4 dB/km in the wavelength range exceeding 1,000 nm but not exceeding 3,000 nm;

1061.5. Lasers

"Lasers", components and optical equipment, as follows:

NOTES:

1. Pulsed "lasers" include those that run in a continuous wave (CW) mode with pulses superimposed.

2. Pulse-excited "lasers" include those that run in a continuously excited mode with pulse excitation superimposed.

3. The embargo status of Raman "lasers" is determined by the parameters of the pumping source "lasers". The pumping source "lasers" can be any of the "lasers" described below.

1061.5. a. Gas "lasers", as follows:

1. Excimer "lasers" having any of the following:
   a. An output wavelength not exceeding 150 nm and:
      1. An output energy exceeding 50 mJ per pulse; or
      2. An average or CW output power exceeding 1 W;
   b. An output wavelength exceeding 150 nm but not exceeding 190 nm and:
      1. An output energy exceeding 1.5 J per pulse; or
      2. An average or CW output power exceeding 120 W;
   c. An output wavelength exceeding 190 nm but not exceeding 360 nm and:
      1. An output energy exceeding 10 J per pulse; or
      2. An average or CW output power exceeding 500 W; or

d. An output wavelength exceeding 360 nm and:

1. An output energy exceeding 1.5 J per pulse; or

2. An average or CW output power exceeding 30 W;

1061. 5. a. 2. Metal vapour "lasers", as follows:

a. Copper (Cu) "lasers" with an average or CW output power exceeding 20 W;

b. Gold (Au) "lasers" with an average or CW output power exceeding 5 W;

c. Sodium (Na) "lasers" with an output power exceeding 5 W;

d. Barium (Ba) "lasers" with an average or CW output power exceeding 2 W;

1061. 5. a. 3. Carbon monoxide (CO) "lasers" having either:

a. An output energy exceeding 2 J per pulse and a pulsed "peak power" exceeding 5 kW; or

b. An average or CW output power exceeding 5 kW;

1061. 5. a. 4. Carbon dioxide (CO_2) "lasers" having any of the following:

a. A CW output power exceeding 10 kW;

b. A pulsed output with a "pulse duration" exceeding 10 microseconds and:

1. An average output power exceeding 10 kW; or

2. A pulsed "peak power" exceeding 100 kW; or

c. A pulsed output with a "pulse duration" equal to or less than 10 microseconds and:

1. A pulse energy exceeding 5 J per pulse and "peak power" exceeding 2.5 kW; or

2. An average output power exceeding 2.5 kW;

1061. 5. a. 5. "Chemical lasers", as follows:

a. Hydrogen Fluoride (HF) "lasers";

b. Deuterium Fluoride (DF) "lasers";

c. "Transfer lasers":
1. Oxygen Iodine (O_2-I) "lasers";

2. Deuterium Fluoride-Carbon dioxide (DF-CO_2) "lasers";

1061. 5. a. 6. Gas discharge and ion "lasers", i.e., krypton ion or argon ion "lasers", having either:

a. An output energy exceeding 1.5 J per pulse and a pulsed "peak power" exceeding 50 W; or

b. An average or CW output power exceeding 50 W;

1061. 5. a. 7. Other gas "lasers", except nitrogen "lasers", having any of the following:

a. An output wavelength not exceeding 150 nm and:

1. An output energy exceeding 50 mJ per pulse and a pulsed "peak power" exceeding 1 W; or

2. An average or CW output power exceeding 5W;

b. An output wavelength exceeding 150 nm but not exceeding 800 nm and:

1. An output energy exceeding 1.5 J per pulse and a pulsed "peak power" exceeding 30 W; or

2. An average or CW output power exceeding 30 W;

c. An output wavelength exceeding 800 nm but not exceeding 1,400 nm and:

1. An output energy exceeding 0.25 J per pulse and a pulsed "peak power" exceeding 10 W; or

2. An average or CW output power exceeding 10 W; or

d. An output wavelength exceeding 1,400 nm and an average or CW output power exceeding 1 W;

1061. 5. b. Semiconductor "lasers", as follows:

Technical Note:
Semiconductor "lasers" are commonly called "laser" diodes.

NOTE:
The embargo status of semiconductor "lasers" specially designed for other equipment is determined by the embargo status of the other equipment.

1. Individual, single-transverse mode semiconductor "lasers" having:

    a. An average output power exceeding 100 mW; or
    b. A wavelength exceeding 1,050 nm;

2. Individual, multiple-transverse mode semiconductor "lasers", or arrays of individual semiconductor "lasers", having:

    a. An output energy exceeding 500 mJ per pulse and a pulsed "peak power" exceeding 10 W;

    b. An average or CW output power exceeding 10 W; or

    c. A wavelength exceeding 1,050 nm;

1061. 5. c. Solid state "lasers", as follows:

1. "Tunable" "lasers" having any of the following:

NOTE:
1061.5.c.1. includes titanium - sapphire (Ti: Al_2O_3), thulium - YAG (Tm: YAG), thulium - YSGG (Tm: YSGG), alexandrite (Cr: $BeAl_2O_4$) and colour centre "lasers".

- a. An output wavelength less than 600 nm and:
  - 1. An output energy exceeding 50 mJ per pulse and a pulsed "peak power" exceeding 1 W; or
  - 2. An average or CW output power exceeding 1 W;
- b. An output wavelength of 600 nm or more but not exceeding 1,400 nm and:
  - 1. An output energy exceeding 1 J per pulse and a pulsed "peak power" exceeding 20 W; or
  - 2. An average or CW output power exceeding 20 W; or
- c. An output wavelength exceeding 1,400 nm and:
  - 1. An output energy exceeding 50 mJ per pulse and a pulsed "peak power" exceeding 1 W; or
  - 2. An average or CW output power exceeding 1 W;

1061. 5. c. 2. Non-"tunable" "lasers", as follows:

NOTE:
1061.5.c.2. includes atomic transition solid state "lasers".

- a. Ruby "lasers" having an output energy exceeding 20 J per pulse;
- b. Neodymium glass "lasers", as follows:
  - 1. "Q-switched lasers" having:
    - a. An output energy exceeding 20 J but not exceeding 50 J per pulse and an average output power exceeding 10 W; or
    - b. An output energy exceeding 50 J per pulse;
  - 2. Non-"Q-switched lasers" having:

a. An output energy exceeding 50 J but not exceeding 100 J per pulse and an average output power exceeding 20 W; or

b. An output energy exceeding 100 J per pulse;

c. Neodymium-doped (other than glass) "lasers", as follows, with an output wavelength exceeding 1,000 nm but not exceeding 1,100 nm;
(For Neodymium-doped (other than glass) "lasers" having an output wavelength not exceeding 1,000 nm or exceeding 1,100 nm, see 1061.5.c.2.d.)

1. With a "pulse duration" of less than 1 ns and:

   a. A "peak power" exceeding 5 GW;

   b. An average output power exceeding 10 W; or

   c. A pulsed energy exceeding 0.1 J;

2. Pulse-excited, "Q-switched" lasers, with a pulse duration equal to or more than 1 ns, and:

   a. A single-transverse mode output with:

      1. A "peak power" exceeding 100 MW;

      2. An average output power exceeding 20 W; or

   b. A multiple-transverse mode output with:

      1. A "peak power" exceeding 200 MW;

      2. An average output power exceeding 50 W; or

      3. A pulsed energy exceeding 2 J;

1061. 5.c.2. c. 3. Pulse-excited, non-"Q-switched lasers", having:

   a. A single-transverse mode output with:

1. A "peak power" exceeding 500 kW; or

2. An average output power exceeding 150 W; or

b. A multiple-transverse mode output with:

1. A "peak power" exceeding 1 MW; or

2. An average power exceeding 500 W;

4. Continuously excited "lasers" having:

a. A single-transverse mode output with:

1. A "peak power" exceeding 500 kW; or

2. An average or CW output power exceeding 150 W; or

b. A multiple-transverse mode output with:

1. A "peak power" exceeding 1 MW; or

2. An average or CW output power exceeding 500 W;

d. Other non-"tunable" "lasers", having any of the following:

1061. 5. c. 2. d. 1. A wavelength less than 150 nm and:

a. An output energy exceeding 50 mJ per pulse and a pulsed "peak power" exceeding 1 W; or

b. An average or CW output power exceeding 1 W;

1061. 5. c. 2. d. 2. A wavelength of 150 nm or more but not exceeding 800 nm and:

a. An output energy exceeding 1.5 J per pulse and a pulsed "peak power" exceeding 30 W; or

b. An average or CW output power exceeding 30 W;

1061. 5. c. 2. d. 3. A wavelength exceeding 800 nm but not exceeding 1,400 nm, as follows:

a. "Q-switched lasers" with:

1. An output energy exceeding 0.5 J per pulse and a pulsed "peak power" exceeding 50 W; or

2. An average output power exceeding:

a. 10 W for single-mode "lasers";

b. 30 W for multimode "lasers";

b. Non-"Q-switched lasers" with:

1. An output energy exceeding 2 J per pulse and a pulsed "peak power" exceeding 50 W; or

2. An average or CW output power exceeding 50 W; or

4. A wavelength exceeding 1,400 nm and:

a. An output energy exceeding 100 mJ per pulse and a pulsed "peak power" exceeding 1 W; or

b. An average or CW output power exceeding 1 W;

1061. 5. d. Dye and other liquid "lasers", having any of the following:

1. A wavelength less than 150 nm and:

a. An output energy exceeding 50 mJ per pulse and a pulsed "peak power" exceeding 1 W; or

b. An average or CW output power exceeding 1 W;

2. A wavelength of 150 nm or more but not exceeding 800 nm and:

a. An output energy exceeding 1.5 J per pulse and a pulsed "peak power" exceeding 20 W;

b. An average or CW output power exceeding 20 W;

c. A pulsed single longitudinal mode oscillator with an average output power exceeding 1 W and a repetition rate exceeding 1 kHz if the "pulse duration" is less than 100 ns;

3. A wavelength exceeding 800 nm but not exceeding 1,400 nm and:

a. An output energy exceeding 0.5 J per pulse and a pulsed "peak power" exceeding 10 W; or

b. An average or CW output power exceeding 10 W; or

4. A wavelength exceeding 1,400 nm and:

a. An output energy exceeding 100 mJ per pulse and a pulsed "peak power" exceeding 1 W; or

b. An average or CW output power exceeding 1 W;

1061. 5. e. Free electron "lasers";

1061. 5. f. Components, as follows:

1. Mirrors cooled either by active cooling or by heat pipe cooling;

Technical Note:
Active cooling is a cooling technique for optical components using flowing fluids within the subsurface (nominally less than 1 mm below the optical surface) of the optical component to remove heat from the optic.

2. Optical mirrors or transmissive or partially transmissive optical or electro-optical components specially designed for use with embargoed "lasers";

1061. 5. g. Optical equipment, as follows:

1. Dynamic wavefront (phase) measuring equipment capable of mapping at least 50 positions on a beam wavefront with:

    a. Frame rates equal to or more than 100 Hz and phase discrimination of at least 5% of the beam's wavelength; or

    b. Frame rates equal to or more than 1,000 Hz and phase discrimination of at least 20% of the beam's wavelength;

2. "Laser" diagnostic equipment capable of measuring "Super-High Power Laser" (SHPL) system angular beam steering errors of equal to or less than 10 microradians;

3. Optical equipment, assemblies or components specially designed for a phased-array SHPL system for coherent beam combination to an accuracy of Lambda/10 at the designed wavelength, or 0.1 micrometre, whichever is the smaller;

4. Projection telescopes specially designed for use with SHPL systems;
(For shared aperture optical elements, capable of operating in SHPL applications, see Item 2023.d. on the Munitions List.)

1061. 6. Magnetometers

1061. 6. "Magnetometers", "magnetic gradiometers", "intrinsic magnetic gradiometers" and compensation systems, and specially designed components therefor, as follows:

NOTE:
1061.6 does not embargo instruments specially designed for biomagnetic measurements for medical diagnostics, unless they incorporate unembedded sensors embargoed by 1061.6.h.

a. "Magnetometers" using "superconductive", optically pumped or nuclear precession (proton/Overhauser) technology having a "noise level" (sensitivity) lower (better) than 0.05 nT rms per square root Hz;

b. Induction coil "magnetometers" having a "noise level" (sensitivity) lower (better) than:

   1. 0.05 nT rms per square root Hz at frequencies of less than 1 Hz;

   2. 1 x 10^{-3} nT rms per square root Hz at frequencies of 1 Hz or more but not exceeding 10 Hz; or

   3. 1 x 10^{-4} nT rms per square root Hz at frequencies exceeding 10 Hz;

c. Fibre optic "magnetometers" having a "noise level" (sensitivity) lower (better) than 1 nT rms per square root Hz;

d. "Magnetic gradiometers" using multiple "magnetometers" embargoed by 1061.6.a., b. or c.;

e. Fibre optic "intrinsic magnetic gradiometers" having a magnetic gradient field "noise level" (sensitivity) lower (better) than 0.3 nT/m rms per square root Hz;

f. "Intrinsic magnetic gradiometers", using technology other than fibre-optic technology, having a magnetic gradient field "noise level" (sensitivity) lower (better) than 0.015 nT/m rms per square root Hz;

g. Magnetic compensation systems for magnetic sensors designed for operation on mobile platforms;

h. "Superconductive" electromagnetic sensors, containing components manufactured from "superconductive" materials:

   1. Designed for operation at temperatures below the "critical temperature" of at least one of their "superconductive" constituents (including Josephson effect devices or "superconductive" quantum interference devices (SQUIDS));

   2. Designed for sensing electromagnetic field variations at frequencies of 1 kHz or less; and:

3. Having any of the following characteristics:

   a. Incorporating thin-film SQUIDS with a minimum feature size of less than 2 micrometres and with associated input and output coupling circuits;

   b. Designed to operate with a magnetic field slew rate exceeding 1 x 10^6 magnetic flux quanta per second;

   c. Designed to function without magnetic shielding in the earth's ambient magnetic field; or

   d. Having a temperature coefficient less (smaller) than 0.1 magnetic flux quantum/K;

1061. 7. Gravimeters

1061. 7. Gravity meters (gravimeters) and gravity gradiometers, as follows:

a. Gravity meters for ground use having a static accuracy of less (better) than 10 microgal;

   NOTE:
   1061.7.a.does not embargo ground gravity meters of the quartz element (Worden) type.

b. Gravity meters for mobile platforms for ground, marine, submersible, space or airborne use having:

   1. A static accuracy of less (better) than 0.7 milligal; and

   2. An in-service (operational) accuracy of less (better) than 0.7 milligal with a time-to-steady-state registration of less than 2 minutes under any combination of attendant corrective compensations and motional influences;

c. Gravity gradiometers;

1061. 8. Radar

1061. 8. Radar systems, equipment and assemblies having any of the following characteristics, and specially designed components therefor:

NOTE:
1061.8. does not embargo:

a. Secondary surveillance radar (SSR);

b. Car radar designed for collision prevention;

c. Displays or monitors used for air traffic control (ATC) having no more than 12 resolvable elements per mm.

a. Operating at frequencies from 40 GHz to 230 GHz and having an average output power exceeding 100 mW;

b. Having a tunable bandwidth exceeding ±6.25% of the centre operating frequency;

c. Capable of operating simultaneously on more than two carrier frequencies;

d. Capable of operating in synthetic aperture (SAR), inverse synthetic aperture (ISAR) or sidelooking airborne (SLAR) radar mode;

e. Incorporating "electronically steerable phased array antennae";

f. Capable of heightfinding non-cooperative targets;

NOTE:
1061.8.f. does not embargo:

a. Precision approach radar equipment (PAR) conforming with ICAO standards;

b. Meteorological (weather) radar.

g. Designed specially for airborne (balloon or airframe mounted) operation and having Doppler signal processing for the detection of moving targets;

h. Employing processing of radar signals using:

1. "Radar spread spectrum" techniques; or

2. "Radar frequency agility" techniques;

i. Providing ground-based operation with a maximum "instrumented range" exceeding 185 km;

   NOTE:
   1061.8.i. does not embargo fishing ground surveillance radar.

j. "Laser" radar or Light Detection and Ranging (LIDAR) equipment, having either of the following:

   1. "Space-qualified"; or

   2. Employing coherent heterodyne or homodyne detection techniques and having an angular resolution of less (better) than 20 microradians;

      NOTE:
      1061.8.j. does not embargo LIDAR equipment specially designed for surveying or for meteorological observation.

k. Having signal processing sub-systems using "pulse compression" with:

   1. A "pulse compression" ratio exceeding 150; or

   2. A pulse width of less than 200 ns; or

l. Having data processing sub-systems with:

   1. "Automatic target tracking" providing, at any antenna rotation, the predicted target position beyond the time of the next antenna beam passage;

      NOTE:
      1061.8.l.1. does not embargo conflict alert capability in ATC systems, or marine or harbour radar.

   2. Calculation of target velocity from primary radar having non-periodic (variable) scanning rates;

   3. Processing for automatic pattern recognition (feature extraction) and comparison with target characteristic data bases (waveforms or imagery) to identify or classify targets; or

1061. 8. 1. 4. Superposition and correlation, or fusion, of target data from two or more "geographically dispersed" and "interconnected radar sensors" to enhance and discriminate targets;

NOTE:
1061.8.1.4. does not embargo systems, equipment and assemblies used for marine traffic control.

1062. Test, Inspection and Production Equipment

1062. 1. Acoustics None.

2. Optical Sensors None.

3. Cameras None.

4. Optics
Equipment for measuring absolute reflectance to an accuracy of ±0.1% of the reflectance value;

5. Lasers
Specially designed or modified equipment, including tools, dies, fixtures or gauges, as follows, and other specially designed components and accessories therefor:
a. For the manufacture or inspection of:

1. Free electron "laser" magnet wigglers; and free electron "laser" photo injectors;

b. For the adjustment, to required tolerances, of the longitudinal magnetic field of free electron "lasers";

6. Magnetometers None.

7. Gravimeters
Equipment to produce, align and calibrate land-based gravity meters with a static accuracy of better than 0.1 milligal;

8. Radar
Pulse radar cross-section measurement systems having transmit pulse widths of 100 ns or less and specially designed components therefor.

1063. Materials

1063. 1. Acoustics None.

2. Optical Sensors

a. Elemental tellurium (Te) of purity levels equal to or more than 99.9995%;

b. Single crystals of cadmium telluride (CdTe) or mercury cadmium telluride (CdHgTe) of any purity level, including epitaxial wafers thereof;

Technical Note:
Purity verified in accordance with ASTM F574-83 standard or equivalents.

c. "Optical fibre preforms" specially designed for the manufacture of high birefringence fibres embargoed by 1061.2.d.3.;

3. Cameras None.

4. Optics

a. Zinc selenide (ZnSe) and zinc sulphide (ZnS) "substrate blanks" produced by the chemical vapour deposition process:

1. Larger than 100 cm^3 in volume; or

2. Larger than 80 mm in diameter with a thickness equal to or more than 20 mm;

b. Boules of the following electro-optic materials:

1. Potassium titanyl arsenate (KTA);

2. Silver gallium selenide (AgGaSe2);

3. Thallium arsenic selenide (Tl3AsSe3, also known as TAS);

c. Non-linear optical materials having:

1. Third order susceptibility (chi 3) equal to or less than 1 W/m^2; and

2. A response time of less than 1 ms;

d. "Substrate blanks" of silicon carbide or beryllium beryllium (Be/Be) deposited materials exceeding 300 mm in diameter or major axis length;

e. Low optical absorption materials, as follows:

  1. Bulk fluoride compounds containing ingredients with a purity of 99.999% or better;

     NOTE:
     1063.4.e.1. embargoes fluorides of zirconium or aluminium and variants.

  2. Bulk fluoride glass made from compounds embargoed by 1063.4.e.1.;

f. Glass, including fused silica, phosphate glass, fluorophosphate glass, zirconium fluoride (ZrF4) and hafnium fluoride (HfF4) with:

  1. A hydroxyl ion (OH-) concentration of less than 5 ppm;

  2. Integrated metallic purity levels of less than 1 ppm; and

  3. High homogeneity (index of refraction variance) less than 5 x 10^{-6};

g. Synthetically produced diamond material with an absorption of less than 10^{-5} cm^{-1} for wavelengths exceeding 200 nm but not exceeding 14,000 nm;

h. "Optical fibre preforms" made from bulk fluoride compounds containing ingredients with a purity of 99.999% or better, specially designed for the manufacture of "fluoride fibres" embargoed by 1061.4.f.;

1063. 5. Lasers

Crystalline "laser" host material in unfinished form, as follows:

a. Titanium doped sapphire;

b. Alexandrite;

6. Magnetometers None.

7. Gravimeters None.

8. Radar None.

1064. Software

1064. 1. "Software" specially designed for the "development" or "production" of equipment embargoed by 1061.4., 1061.5., 1061.8. or 1062.8.;

2. "Software" specially designed for the "use" of equipment embargoed by 1061.2.b., 1061.8. or 1062.8.;

3. Other "software", as follows:
   a. Acoustics

      1. "Software" specially designed for acoustic beam forming for the "real time processing" of acoustic data for passive reception using towed hydrophone arrays;

      2. "Source code" for the "real time processing" of acoustic data for passive reception using towed hydrophone arrays;

   b. Optical Sensors None.

   c. Cameras None.

   d. Optics None.

   e. Lasers None.

   f. Magnetometers

      1. "Software" specially designed for magnetic compensation systems for magnetic sensors designed to operate on mobile platforms;

      2. "Software" specially designed for magnetic anomaly detection on mobile platforms;

   g. Gravimeters

      "Software" specially designed to correct motional influences of gravity meters or gravity gradiometers;

h. Radar

1. Air Traffic Control "software" application "programmes" hosted on general purpose computers located at Air Traffic Control centres and capable of any of the following:

    a. Processing and displaying more than 150 simultaneous "system tracks";

    b. Accepting radar target data from more than four primary radars; or

    c. Automatically handing over primary radar target data (if not correlated with secondary surveillance radar (SSR) data) from the host ATC centre to another ATC centre;

2. "Software" for the design or "production" of radomes which:

    a. Are specially designed to protect the "electronically steerable phased array antennae" embargoed by 1061.8.e.; and

    b. Limit the average side-lobe level increase by less than 13 dB for frequencies equal to or higher than 2 GHz;

1065. Technology

1065. 1. Technology according to the General Technology Note for the "development" of equipment, materials or "software" embargoed by 1061., 1062., 1063. or 1064.;

2. Technology according to the General Technology Note for the "production" of equipment or materials embargoed by 1061., 1062. or 1063.;

3. Other technology:

    a. Acoustics None.

    b. Optical Sensors None.

    c. Cameras None.

    d. Optics

1. Optical surface coating and treatment technology required to achieve uniformity of 99.5% or better for optical coatings 500 mm or more in diameter or major axis length and with a total loss (absorption and scatter) of less than 5 x 10^{-3};

2. Optical fabrication technologies, as follows:

   a. For serially producing optical components at a rate exceeding 10 m² of surface area per year on any single spindle and with:

      1. An area exceeding 1 m²; and

      2. A surface figure exceeding lambda/10 rms at the designed wavelength;

   b. Single point diamond turning techniques producing surface finish accuracies of better than 10 nm rms on non-planar surfaces exceeding 0.5 m²; (See also 1025.3.d.)

e. Lasers

   1. Technology for optical filters with a bandwidth equal to or less than 10 nm, a field of view (FOV) exceeding 40° and a resolution exceeding 0.75 line pairs per mm;

   2. "Technology" "required" for the "development", "production" or "use" of specially designed diagnostic instruments or targets in test facilities for "Super High Power Lasers" (SHPL) testing or testing or evaluation of materials irradiated by SHPL beams;

f. Magnetometers

   Technology "required" for the "development" or "production" of fluxgate "magnetometers" or fluxgate "magnetometer" systems having a noise level:

   1. Less than 0.05 nT rms per square root Hz at frequencies of less than 1 Hz; or
   2. 1 x 10^{-3} nT rms per square root Hz at frequencies of 1 Hz or more;

g. Gravimeters None.

h. Radar None.

NOTES:
Acoustics

1. Governments may permit, as administrative exceptions, the shipment of equipment embargoed by 1061.1.a.1.b.4. for use in civil research or civil exploration work.

Optical Sensors

2. Governments may permit, as administrative exceptions, the shipment of "multispectral imaging sensors" embargoed by 1061.2.b.2.a. or 1061.2.b.2.b.2. provided the Instantaneous Field-Of-View (IFOV) of the "multispectral imaging sensor" is equal to or more than 2.5 milliradians.

3. Governments may permit, as administrative exceptions, the shipment of reasonable quantities of non ruggedized image intensifier tubes embargoed by 1061.2.a.2.a.3.a. for bona fide medical use.

4. Governments may permit, as administrative exceptions, the shipment in reasonable quantities to COCOM-agreed countries of non-ruggedised equipment operating in the visible spectrum, embargoed by 1061.2.c., and containing image intensifier tubes embargoed by 1061.2.a.2.a.3.a., provided they are to be used for civil certified end-uses by civil end-users.

5. The Committee will favourably consider the export of reasonable quantities of image intensifier tubes embargoed by 1061.2.a.2.a.3.a. which are non-ruggedised and which are intended for equipment listed in the Note to 1061.2.c. The Committee will approve the export of equipment described in this Note if no member country has raised an objection within four weeks of the receipt of complete information on the case.

Optics

6. Governments may permit, as administrative exceptions, the shipment of the following for installation and use at ground-based bona fide

academic or civilian astronomical research sites or in international air- or space-based bona fide academic or civilian astronomical research projects: For the stated end-use, a limit of:

a. One optical mirror embargoed by 1061.4.a.1.;

b. Three optical mirrors embargoed by 1061.A.4.a.2.;

c. Three optical mirrors embargoed by 1061.4.a.4.;

d. Three optical components embargoed by 1061.4.b.;

e. Ten optical filters embargoed by 1061.4.d.1.a.;

f. One piece of optical control equipment embargoed by 1061.4.e.2. for each operational mirror;

g. Four pieces of optical control equipment embargoed by 1061.4.e.4.;

h. Three "substrate blanks" embargoed by 1063.4.a.;

i. A reasonable quantity of the bulk fluoride glass embargoed by 1063.4.e.2.;

j. A reasonable quantity of the materials embargoed by 1063.4.f.

N.B.: The above limitations refer to specific projects.

Lasers

7. Governments may permit, as administrative exceptions, the shipment, for civil applications, of "lasers", as follows:

a. Neodymium-doped (other than glass), pulse-excited, "Q-switched lasers" embargoed by 1061.5.c.2.c.2.b. having:

1. A pulse duration equal to or more than 1 ns; and

2. A multiple-transverse mode output with a "peak power" not exceeding 400 MW;

b. Neodymium-doped (other than glass) "lasers" embargoed by 1061.5.c.2.c.3.b. or 1061.5.c.2.c.4.b.:

1. Having:

a. An output wavelength exceeding 1,000 nm but not exceeding 1,100 nm; and

b. An average or CW output power not exceeding 2 kW; and

2. Being:

a. Pulse-excited, non-"Q-switched" multiple-tranverse mode; or

b. continuously excited, multiple-transverse mode;

c. Carbon dioxide "lasers" embargoed by 1061.5.a.4.:

1. Being in CW multiple-tranverse mode; and

2. Having a CW output power not exceeding 15 kW.

Lasers

8. Governments may permit, as administrative exceptions, the shipment of optical equipment embargoed by 1061.5.g. when intended for use with unembargoed lasers or embargoed lasers the export of which has been authorized by the Committee.

Radar

9. Governments may permit, as administrative exceptions, the shipment of ground radar equipment specially designed for enroute air traffic control, and "software" specially designed for the "use" thereof, provided:

a. It is embargoed by 1061.8.i.;

b. It has a maximum "instrumented range" of 500 km or less;

c. It is configured so that the radar target data can be transmitted only one way from the radar site to one or more civil ATC centres;

d. It contains no provisions for remote control of the radar scan rate from the enroute ATC centre; and

e. It is to be permanently installed under the supervision of the exporter or the exporter's Western agent, so that the "instrument range" and volumetric coverage of the radar encompasses an ICAO air route.

N.B.: The "use" "software" must be limited to "object code" and the minimum amount of "source code" necessary for installation, operation or maintenance.

10. Governments may permit, as administrative exceptions, the shipment of ATC "software" application "programmes" embargoed by 1064.3.h.1., provided:

a. The number of "system tracks" does not exceed 700;

b. The number of primary radar inputs does not exceed 32; and

c. The "software" is further limited to "object code" and the minimum amount of "source code" necessary for installation, operation or maintenance.

1070. NAVIGATION AND AVIONICS

1071. Equipment, Assemblies and Components

1. Accelerometers designed for use in inertial navigation or guidance systems and having any of the following characteristics, and specially designed components therefor:

a. A "bias" "stability" of less (better) than 130 micro g with respect to a fixed calibration value over a period of one year;

b. A "scale factor" "stability" of less (better) than 130 ppm with respect to a fixed calibration value over a period of one year;

c. Specified to function at acceleration levels exceeding 100 g;

1071. 2. Gyros having any of the following characteristics, and specially designed components therefor:

a. A "drift rate" "stability", when measured in a 1 g environment over a period of three months and with respect to a fixed calibration value, of:

1. Less (better) than 0.1° per hour when specified to function continuously below 10 g; or

2. Less (better) than 0.5° per hour when specified to function from 10 to 100 g inclusive;

b. Specified to function at acceleration levels above 100 g;

1071. 3. Inertial navigation systems (gimballed and strapdown) and inertial equipment for attitude, guidance or control having any of the following characteristics, and specially designed components therefor:

a. For "aircraft":

1. Navigation error (free inertial) of 0.8 nautical mile per hour (50% Circular Error Probable (CEP)) or less (better) subsequent to normal alignment;

2. Not certified for use on "civil aircraft" by civil aviation authorities of a member country; or

3. Specified to function at acceleration levels exceeding 10 g;

b. For land or "spacecraft":

1. Navigation error (free inertial) of 0.8 nautical mile per hour (50% CEP) or less (better) subsequent to normal alignment; or

2. Specified to function at acceleration levels exceeding 10 g;

1071. 4. Gyro-astro compasses, and other devices which derive position or orientation by means of automatically tracking celestial bodies or satellites, with an azimuth accuracy of equal to or less (better) than 5 seconds of arc;

1071. 5. Global Positioning Satellite (GPS) receiving equipment having either of the following characteristics, and specially designed components therefor:

a. Employing encryption/decryption; or

b. A null-steerable antenna;

1071. 6. Airborne altimeters operating at frequencies other than 4.2 to 4.4 GHz inclusive, having either of the following characteristics:

a. "Power management"; or

b. Using phase shift key modulation;

1072. Test, Inspection and Production Equipment

1072. 1. Test, calibration or alignment equipment specially designed for equipment embargoed by 1071., except equipment for Maintenance Level I or Maintenance Level II;

Technical Notes:

1. Maintenance Level I The failure of an inertial navigation unit is detected on the aircraft by indications from the control and display unit (CDU) or by the status message from the corresponding sub-system. By following the manufacturer's manual, the cause of the failure may be localised at the level of the malfunctioning line replaceable unit (LRU). The operator then removes the LRU and replaces it with a spare.
2. Maintenance Level II The defective LRU is sent to the maintenance workshop (the manufacturer's or that of the operator responsible for level II maintenance). At the maintenance workshop, the malfunctioning LRU is tested by various appropriate means to verify and localise the defective shop replaceable assembly (SRA) module responsible for the failure. This SRA is removed and replaced by an operative spare. The defective SRA (or possibly the complete LRU) is then shipped to the manufacturer.

N.B.: Maintenance Level II does not include the removal of embargoed accelerometers or gyro sensors from the SRA.

1072. 2. Equipment, as follows, specially designed to characterize mirrors for ring "laser" gyros:

a. Scatterometers having a measurement accuracy of 10 ppm or less (better);

b. Profilometers having a measurement accuracy of 0.5 nm (5 angstrom) or less (better);

1072. 3. Equipment specially designed for the production of equipment embargoed by 1071., including:

a. Gyro tuning test stations;

b. Gyro dynamic balance stations;

c. Gyro run-in/motor test stations;

d. Gyro evacuation and fill stations;

e. Centrifuge fixtures for gyro bearings;

f. Accelerometer axis align stations;

1073. Materials

None.

1074. Software

1. "Software" specially designed or modified for the "development" or "production" of equipment embargoed by 1071. or 1072.;

2. "Source code" for the "use" of any inertial navigation equipment or Attitude Heading Reference Systems (AHRS) (except gimballed AHRS) including inertial equipment not embargoed by 1071.3. or 1071.4.;

Technical Note:
AHRS generally differ from inertial navigation systems (INS) in that an AHRS provides attitude heading information and normally does not provide the acceleration, velocity and position information associated with an INS.

3. Other "software", as follows:
    - a. "Software" specially designed or modified to improve the operational performance or reduce the navigational error of systems to the levels specified in 1071.3. or 1071.4.;
    - b. "Source code" for hybrid integrated systems which improves the operational performance or reduces the navigational error of systems to the level specified in 1071.3. by continuously combining inertial data with any of the following navigation data:
        1. Doppler radar velocity;
        2. Global Positioning Satellite (GPS) references; or
        3. Terrain data base;
    - c. "Source code" for integrated avionics or mission systems which combine sensor data and employ knowledge-based expert systems;
    - d. "Source code" for the "development" of:
        1. Digital flight management systems for flight path optimization;
        2. Integrated propulsion and flight control systems;
        3. Fly-by-wire or fly-by-light control systems;
        4. Fault-tolerant or self-reconfiguring "active flight control systems";
        5. Airborne automatic direction finding equipment;
        6. Air data systems based on surface static data;
        7. Raster-type head-up displays or three dimensional displays;

1075. Technology

1. Technology according to the General Technology Note for the "development" of equipment or "software" embargoed by 1071., 1072. or 1074.;
2. Technology according to the General Technology Note for the "production" of equipment embargoed by 1071.or 1072.;

3. Technology according to the General Technology Note for the repair, refurbishing or overhaul of equipment embargoed by 1071.1. to 1071.4., except for maintenance technology directly associated with calibration, removal or replacement of damaged or unserviceable LRUs and SRAs of a "civil aircraft" as described in Maintenance Level I or Maintenance Level II. (see Technical Notes to 1072.1.)

4. Other technology, as follows:

   a. Technology for the "development" or "production" of:

      1. Airborne automatic direction finding equipment operating at frequencies exceeding 5 MHz;

      2. Air data systems based on surface static data only, i.e., which dispense with conventional air data probes;

      3. Raster-type head-up displays or three dimensional displays for "aircraft";

      4. Inertial navigation systems or gyro-astro compasses containing accelerometers or gyros embargoed by 1071.1. or 1071.2.;

   b. "Development" technology, as follows, for "active flight control systems" (including fly-by-wire or fly-by-light):

      1. Configuration design for interconnecting multiple microelectronic processing elements (on-board computers) to achieve "real time processing" for control law implementation;

      2. Control law compensation for sensor location or dynamic airframe loads, i.e., compensation for sensor vibration environment or for variation of sensor location from the centre of gravity;

      3. Electronic management of data redundancy or systems redundancy for fault detection, fault tolerance, fault isolation or reconfiguration;
         NOTE:
         1075.4.b.3. does not embargo technology for the design of physical redundancy.

      4. Flight controls which permit inflight reconfiguration of force and moment controls for real time autonomous air vehicle control;

5. Integration of digital flight control, navigation and propulsion control data into a digital flight management system for flight path optimization, except "development" technology for aircraft flight instrument systems integrated solely for VOR, DME, ILS or MLS navigation or approaches;

6. Full authority digital flight control or multi sensor mission management systems incorporating knowledge-based expert systems; (For technology for Full Authority Digital Engine Control (FADEC), see 1095.3.a.10.)

c. Technology for the "development" of helicopter systems, as follows:

1. Multi-axis fly-by-wire or fly-by-light controllers which combine the functions of at least two of the following into one controlling element:

a. Collective controls;

b. Cyclic controls;

c. Yaw controls;

2. "Circulation-controlled anti-torque or circulation- controlled directional control systems";

3. Rotor blades incorporating "variable geometry airfoils" for use in systems using individual blade control.

1080. MARINE

1081. Equipment, Assemblies and Components

1081. 1. Submersible vehicles or surface vessels, as follows:

NOTE:
For the embargo status of equipment for submersible vehicles, see: Category 1150 "Information Security" for encrypted communication equipment; Category 1060 for sensors; Categories 1070 and 1080 for navigation equipment; Item 1081. for underwater equipment.

1081. 1. a. Manned, tethered submersible vehicles designed to operate at depths exceeding 1,000 m;

b. Manned, untethered submersible vehicles:

1. Designed to "operate autonomously" and having a lifting capacity of:

a. 10% or more of their weight in air; and

b. 15 kN or more;

2. Designed to operate at depths exceeding 1,000 m; or

3. a. Designed to carry a crew of 4 or more;

b. Designed to "operate autonomously" for 10 hours or more;

c. Having a "range" of 25 nautical miles or more; and

d. Having a length of 21 m or less;

Technical Note:
"Operate autonomously" Fully submerged, without snorkel, all systems working and cruising at minimum speed at which the submersible can safely control its depth dynamically by using its depth planes only, with no need for a support vessel or support base on the surface, sea-bed or shore, and containing a propulsion system for submerged or surface use.

Technical Note:
"Range". Half the maximum distance a submersible vehicle can cover.

c. Unmanned, tethered submersible vehicles designed to operate at depths exceeding 1,000 m:

1. Designed for self-propelled manoeuvre using propulsion motors or thrusters embargoed by 1081.2.a.2.; or

2. Having a fibre optic data link;

d. Unmanned, untethered submersible vehicles:

1. Designed for deciding a course relative to any geographical reference without real-time human assistance;

2. Having an acoustic data or command link; or

3. Having a fibre optic data or command link exceeding 1,000 m;

e. Ocean salvage systems with a lifting capacity exceeding 5 MN for salvaging objects from depths exceeding 250 m and having either of the following:

  1. Dynamic positioning systems capable of position keeping within 20 m of a given point provided by the navigation system; or

  2. Seafloor navigation and navigation integration systems for depths exceeding 1,000 m with positioning accuracies to within 10 m of a predetermined point;

f. Surface-effect vehicles (fully skirted variety) with a maximum design speed, fully loaded, exceeding 30 knots in a significant wave height of 1.25 m (Sea State 3) or more, a cushion pressure exceeding 3,830 Pa, and a light-ship-to- full-load displacement ratio of less than 0.70;

g. Surface-effect vehicles (rigid sidewalls) with a maximum design speed, fully loaded, exceeding 40 knots in a significant wave height of 3.25 m (Sea State 5) or more;

h. Hydrofoil vessels with active systems for automatically controlling foil systems, with a maximum design speed, fully loaded, of 40 knots or more in a significant wave height of 3.25 m (Sea State 5) or more;

i. Small waterplane area vessels with:

  1. A full load displacement exceeding 500 tonnes with a maximum design speed, fully loaded, exceeding 35 knots in a significant wave height of 3.25 m (Sea State 5) or more; or

  2. A full load displacement exceeding 1,500 tonnes with a maximum design speed, fully loaded, exceeding 25 knots in a Sea State 6 or more;

1081. 2. Systems or equipment, as follows:

  a. Systems or equipment, specially designed or modified for submersible vehicles, designed to operate at depths exceeding 1,000 m, as follows:

    1. Pressure housings or pressure hulls with a maximum inside chamber diameter exceeding 1.5 m;

    2. Direct current propulsion motors or thrusters;

3. Umbilical cables, and connectors therefor, using optical fibre and having synthetic strength members;

b. Systems specially designed or modified for the automated control of the motion of equipment for submersible vehicles embargoed by 1081.1. using navigation data and having closed loop servo-controls to:

1. Enable a vehicle to move within 10 m of a predetermined point in the water column;

2. Maintain the position of the vehicle within 10 m of a predetermined point in the water column; or

3. Maintain the position of the vehicle within 10 m while following a cable on or under the seabed;

c. Fibre optic hull penetrators or connectors;

d. Underwater vision systems, as follows:

1. a. Television systems (comprising camera, lights, monitoring and signal transmission equipment) having a limiting resolution when measured in air of more than 500 lines and specially designed or modified for remote operation with a submersible vehicle; or

   b. Underwater television cameras having a limiting resolution when measured in air of more than 700 lines;

2. Systems, specially designed or modified for remote operation with an underwater vehicle, employing techniques to minimise the effects of back scatter, including range-gated illuminators or "laser" systems;

3. Low light level television cameras specially designed or modified for underwater use containing:

   a. Image intensifier tubes embargoed by 1061.2.a.2.a.; and

   b. More than 150,000 "active pixels" per solid state area array;

e. Photographic still cameras specially designed or modified for underwater use, having a film format of 35 mm or larger, and:

   1. Annotating the film with data provided by a source external to the camera;

   2. Having autofocussing or remote focussing specially designed for underwater use;

   3. Having automatic back focal distance correction; or

   4. Having automatic compensation control specially designed to permit an underwater camera housing to be usable at depths exceeding 1,000 m;

f. Electronic imaging systems, specially designed or modified for underwater use, capable of storing digitally more than 50 exposed images;

g. Light systems, as follows, specially designed or modified for underwater use:
   1. Stroboscopic light systems capable of a light output energy of more than 300 J per flash;
   2. Argon arc light systems specially designed for use below 1,000 m;

h. "Robots" specially designed for underwater use, controlled by using a dedicated stored programme computer:

   1. Having systems that control the "robot" using information from sensors which measure force or torque applied to an external object, distance to an external object, or tactile sense between the "robot" and an external object; or

   2. Capable of exerting a force of 250 N or more or a torque of 250 Nm or more and using titanium based alloys or "fibrous or filamentary" "composite" materials in their structural members;

i. Remotely controlled articulated manipulators specially designed or modified for use with submersible vehicles:

   1. Having systems which control the manipulator using the information from sensors which measure the torque or force applied to an

external object, or tactile sense between the manipulator and an external object; or

2. Controlled by proportional master-slave techniques or by using a dedicated stored programme computer, and having 5 degrees of freedom of movement or more;

NOTE:
Only functions having proportional control using positional feedback or by using a dedicated stored programme computer are counted when determining the number of degrees of freedom of movement.

j. Air independent power systems, as follows, specially designed for underwater use:

1. Brayton, Stirling or Rankine cycle engine air independent power systems having any of the following:

a. Chemical scrubber or absorber systems specially designed to remove carbon dioxide, carbon monoxide and particulates from recirculated engine exhaust;

b. Systems specially designed to use a monoatomic gas;

c. Devices or enclosures specially designed for underwater noise reduction in frequencies below 10 kHz, or special mounting devices for shock mitigation; or

d. Systems specially designed:

1. To pressurise the products of reaction or for fuel reformation;

2. To store the products of the reaction; and

3. To discharge the products of the reaction against a pressure of 100 kPa or more;

2. Diesel cycle engine air independent systems, having all of the following:

a. Chemical scrubber or absorber systems specially designed to remove carbon dioxide, carbon monoxide and particulates from recirculated engine exhaust;

b. Systems specially designed to use a monoatomic gas;

c. Devices or enclosures specially designed for underwater noise reduction in frequencies below 10 kHz or special mounting devices for shock mitigation; and

d. Specially designed exhaust systems that do not exhaust continuously the products of combustion;

3. Fuel cell air independent power systems with an output exceeding 2 kW having either of the following:

1081. 2. j. 3. a. Devices or enclosures specially designed for underwater noise reduction in frequencies below 10 kHz or special mounting devices for shock mitigation; or

b. Systems specially designed:

1. To pressurise the products of reaction or for fuel reformation;

2. To store the products of the reaction; and

3. To discharge the products of the reaction against a pressure of 100 kPa or more;

k. Skirts, seals and fingers, as follows:

1. Designed for cushion pressures of 3,830 Pa or more, operating in a significant wave height of 1.25 m or more and specially designed for surface effect vehicles (fully skirted variety) embargoed by 1081.1.g.;

2. Designed for cushion pressures of 6,224 Pa or more, operating in a significant wave height of 3.25 m (Sea State 5) or more and specially designed for surface effect vehicles (rigid sidewalls) embargoed by 1081.1.g.;

l. Lift fans rated at more than 400 kW specially designed for surface effect vehicles embargoed by 1081.1.f. or 1081.1.g.;

m. Fully submerged subcavitating or supercavitating hydrofoils specially designed for vessels embargoed by 1081.1.h.;

n. Active systems specially designed or modified to control automatically the sea-induced motion of vehicles or vessels embargoed by 1081.1.f., g., h. or i.;

o. 1. Water-screw propeller or power transmission systems, as follows, specially designed for surface effect vehicles (fully skirted or rigid sidewall variety), hydrofoils or small water-plane area vessels embargoed by 1081.1.f., g., h. or i.:

   a. Supercavitating, super-ventilated, partially-submerged or surface piercing propellers rated at more than 7.5 MW;

   b. Contrarotating propeller systems rated at more than 15 MW;

   c. Systems employing pre-swirl or post-swirl techniques for smoothing the flow into a propeller;

   d. Light-weight, high capacity (K factor exceeding 300) reduction gearing;

   e. Power transmission shaft systems, incorporating "composite" material components, capable of transmitting more than 1 MW;

2. Water-screw propeller, power generation or transmission systems for use on vessels, as follows:

   a. Controllable-pitch propellers and hub assemblies rated at more than 30 MW;

   b. Internally liquid-cooled electric propulsion engines with a power output exceeding 2.5 MW;

   c. "Superconductive" propulsion engines, or permanent magnet electric propulsion engines, with a power output exceeding 0.1 MW;

d. Power transmission shaft systems, incorporating "composite" material components, capable of transmitting more than 2 MW;

e. Ventilated or base-ventilated propeller systems rated at more than 2.5 MW;

3. Noise reduction systems for use on vessels of 1,000 tonnes displacement or more, as follows:

a. Noise reduction systems that attenuate at frequencies below 500 Hz and consist of compound acoustic mounts for the acoustic isolation of diesel engines, diesel generator sets, gas turbines, gas turbine generator sets, propulsion motors or propulsion reduction gears, specially designed for sound or vibration isolation, having an intermediate mass exceeding 30% of the equipment to be mounted;

b. Active noise reduction or cancellation systems, or magnetic bearings, specially designed for power transmission systems, and incorporating electronic control systems capable of actively reducing equipment vibration by the generation of anti-noise or anti-vibration signals directly to the source;

p. Pumpjet propulsion systems with a power output exceeding 2.5 MW using divergent nozzle and flow conditioning vane techniques to improve propulsive efficiency or reduce propulsion-generated underwater - radiated noise;

1082. Test, Inspection and Production Equipment

Water tunnels, having a background noise of less than 100 dB (reference 1 micropascal, 1 Hz) in the frequency range from 0 to 500 Hz, designed for measuring acoustic fields generated by a hydro-flow around propulsion system models;

1083. Materials

1083. Synthetic foam for underwater use:

1. Designed for marine depths exceeding 1,000 m; and
2. With a density less than 561 kg/m^3;

Technical Note: Synthetic foam consists of hollow spheres of plastic or glass embedded in a resin matrix.

1084. Software

1084. 1. "Software" specially designed or modified for the "development", "production" or "use" of equipment or materials embargoed by 1081., 1082. or 1083.;

2. Specific "software" specially designed or modified for the "development", "production", repair, overhaul or refurbishing (re-machining) of propellers specially designed for underwater noise reduction;

1085. Technology

1085. 1. Technology according to the General Technology Note for the "development" or "production" of equipment or materials embargoed by 1081., 1082. or 1083.;

2. Other technology, as follows:
   a. Technology for the "development", "production", repair, overhaul or refurbishing (re-machining) of propellers specially designed for underwater noise reduction;

   b. Technology for the overhaul or refurbishing of equipment embargoed by 1081.1.,1081.2.b.,j.,o or p.

   NOTE:
   Governments may permit, as administrative exceptions, the shipment for civil end-uses (e.g., underwater oil, gas or mining operations) of manipulators embargoed by 1081.2.i.2. having 5 degrees of freedom of movement.

1090. PROPULSION

1091. Equipment, Assemblies and Components

1091. 1. Aero gas turbine engines incorporating any of the technologies embargoed by 1095., as follows:

a. Not certified for the specific "civil aircraft" for which they are intended;

NOTE:
For the purpose of the "civil aircraft" certification process, a limited number of civil certified engines, assemblies or components may be exported as determined by Member Governments. This limited number is defined as the minimum required (up to 16, including spares) for civil certification.

b. Not certified for civil use by the aviation authorities in a member country;

c. Designed to cruise at speeds exceeding Mach 1.2 for more than thirty minutes;

1091. 2. Marine gas turbine engines with an ISO standard continuous power rating of 13,795 kW or more and a specific fuel consumption of less than 0.243 kg/kWh, and specially designed assemblies and components therefor;

1091. 3. Specially designed assemblies and components, incorporating any of the technologies embargoed by 1095.3.a., for the following gas turbine engine propulsion systems:

a. Embargoed by 1091.1.; or

b. Whose design or production origins are either proscribed countries or unknown to the manufacturer;

NOTE:
1091.3. does not embargo multiple domed combustors operating at average burner outlet temperatures equal to or less than 1,813 K (1,540° C).

1091. 4. Space launch vehicles or "spacecraft" (not including their payloads); (For the embargo status of products contained in "spacecraft" payloads, see the appropriate Categories.)

1091. 5. Liquid rocket propulsion systems containing any of the systems or components embargoed by 1091.6.;

1091. 6. Systems or components, as follows, specially designed for liquid rocket propulsion systems:

a. Cryogenic refrigerators, flightweight dewars, cryogenic heat pipes or cryogenic systems specially designed for use in space vehicles and capable of restricting cryogenic fluid losses to less than 30% per year;

b. Cryogenic containers or closed-cycle refrigeration systems capable of providing temperatures of 100 K (-173° C) or less for "aircraft" capable of sustained flight at speeds exceeding Mach 3, launch vehicles or "spacecraft";

c. Slush hydrogen storage or transfer systems;

d. High pressure (exceeding 17.5 MPa) turbo pumps, pump components or their associated gas generator or expander cycle turbine drive systems;

e. High-pressure (exceeding 10.6 MPa) thrust chambers and nozzles therefor;

f. Propellant storage systems using the principle of capillary containment or positive expulsion (i.e., with flexible bladders);

1091. 7. Solid rocket propulsion systems with any of the following:

a. 1. Total impulse capacity exceeding 1.1 MNs; or

2. Specific impulse of 2.4 kNs/kg or more when the nozzle flow is expanded to ambient sea level conditions for an adjusted chamber pressure of 7 MPa;

b. 1. Stage mass fractions exceeding 88%; and

2. Propellant solid loadings exceeding 86%;

c. Any of the components embargoed by 1091.8.; or

d. Insulation and propellant bonding systems using direct-bonded motor designs to provide a strong mechanical bond or a barrier to chemical migration between the solid propellant and case insulation material;

1091. 8. Components, as follows, specially designed for solid rocket propulsion systems:

a. Insulation and propellant bonding systems using liners to provide a strong mechanical bond or a barrier to chemical migration between the solid propellant and case insulation material;

b. Filament-wound "composite" motor cases exceeding 0.61 m in diameter or having structural efficiency ratios (PV/W) exceeding 25 km;

Technical Note:
The structural efficiency ratio (PV/W) is the burst pressure (P) multiplied by the vessel volume (V) divided by the total pressure vessel weight (W).

c. Nozzles with thrust levels exceeding 45 kN or nozzle throat erosion rates of less than 0.075 mm/s;

d. Movable nozzle or secondary fluid injection thrust vector control systems capable of:

1. Omni-axial movement exceeding ±5°;

2. Angular vector rotations of 20°/s or more; or

3. Angular vector accelerations of $40°/s^2$ or more;

Technical Note:
For the purposes of 1091.7.d. and 1091.8.a., a strong mechanical bond means bond strength equal to or more than propellant strength.

1091. 9. Hybrid rocket propulsion systems with:

a. Total impulse capacity exceeding 1.1 MNs; or

b. Thrust levels exceeding 220 kN in vacuum exit conditions;

1091. 10. Specially designed components or structures, for launch vehicles or launch vehicle propulsion systems, manufactured using metal "matrix" "composite", organic "composite", ceramic "matrix" or intermetallic reinforced materials embargoed by 1013.7 or 1013.10;

1091. 11. Ramjet, scramjet or combined cycle engines and specially designed components therefor;

1092. Test, Inspection and Production Equipment

1092. 1. Specially designed equipment, tooling or fixtures, as follows, for manufacturing or measuring gas turbine blades, vanes or tip shroud castings:

a. Automated equipment using non-mechanical methods for measuring airfoil wall thickness;

b. Tooling, fixtures or measuring equipment for the "laser", water jet or ECM/EDM hole drilling processes embargoed by 1095.3.c.;

c. Directional solidification or single crystal casting equipment;

d. Ceramic cores or shells;

e. Ceramic core manufacturing equipment or tools;

f. Ceramic core leaching equipment;

g. Ceramic shell wax pattern preparation equipment;

h. Ceramic shell burn out or firing equipment;

1092. 2. On-line (real time) control systems, instrumentation (including sensors) or automated data acquisition and processing equipment, specially designed for the development of gas turbine engines, assemblies or components incorporating technologies embargoed by 1095.3.a;

1092. 3. Equipment specially designed for the production or test of gas turbine brush seals designed to operate at tip speeds exceeding 335 m/s, and specially designed parts or accessories therefor;

1092. 4. Tools, dies or fixtures for the solid state joining of gas turbine "superalloy" or titanium components;

1092. 5. On-line (real time) control systems, instrumentation (including sensors) or automated data acquisition and processing equipment, specially designed for use with the following wind tunnels or devices:

a. Wind tunnels designed for speeds of Mach 1.2 or more, except those specially designed for educational purposes and having a test section size (measured laterally) of less than 250 mm;

Technical Note:
Test section size: the diameter of the circle, or the side of the square, or the longest side of the rectangle, at the largest test

section location.

b. Devices for simulating flow-environments at speeds exceeding Mach 5, including hot-shot tunnels, plasma arc tunnels, shock tubes, shock tunnels, gas tunnels and light gas guns;

c. Wind tunnels or devices, other than two-dimensional sections, capable of simulating Reynolds number flows exceeding 25 x 10^n;

1092. 6. Specially designed acoustic vibration test equipment capable of producing sound pressure levels of 160 dB or more (referenced to 20 micropascals) with a rated output of 4 kW or more at a test cell temperature exceeding 1,273 K (1,000° C), and specially designed transducers, strain gauges, accelerometers, thermocouples or quartz heaters therefor;

1092. 7. Equipment specially designed for inspecting the integrity of rocket motors using non-destructive test (NDT) techniques other than planar X-ray or basic physical or chemical analysis;

1092. 8. Transducers specially designed for the direct measurement of the wall skin friction of the test flow with a stagnation temperature exceeding 833 K (560° C);

1092. 9. Tooling specially designed for producing turbine engine powder metallurgy rotor components capable of operatin at stress levels of 60% of ultimate tensile strength (UTS) or more and metal temperatures of 873 K (600° C) or more;

1093. Materials

None.

1094. Software

1094. 1. "Software" required for the "development" of equipment or technology embargoed by 1091., 1092. or 1095.3.;

1094.2. "Software" required for the "production" of equipment embargoed by 1091. or 1092.;

1094.3. "Software" required for the "use" of full authority digital electronic engine controls (FADEC) for propulsion systems embargoed by 1091. or equipment embargoed by 1092., as follows:

a. "Software" in digital electronic controls for propulsion systems, aerospace test facilities or air breathing aero-engine test facilities;

b. Fault-tolerant "software" used in FADEC systems for propulsion systems and associated test facilities;

1094. 4. Other "software", as follows:

a. "Software" specially designed for vibration test equipment using real time digital controls with individual exciters (thrusters) with a maximum thrust exceeding 100 kN;

b. 2D or 3D viscous "software" validated with wind tunnel or flight test data required for detailed engine flow modelling;

c. "Software" required for the "development" or "production" of real time full authority electronic test facilities for engines or components embargoed by 1091.;

d. "Software" for testing aero gas turbine engines, assemblies or components, specially designed to collect, reduce and analyse data in real time, and capable of feedback control, including the dynamic adjustment of test articles or test conditions, as the test is in progress;

e. "Software" specially designed to control directional solidification or single crystal casting;

f. "Software" in "source code", "object code" or machine code required for the "use" of active compensating systems for rotor blade tip clearance control;

NOTE:
1094.4.f. does not embargo "software" embedded in unembargoed equipment or required for maintenance activities associated with the calibration or repair or updates to the active compensating clearance control system.

1095. Technology

1095. 1. Technology according to the General Technology Note for the "development" of equipment or "software" embargoed by 1091.1.c., 1091.4. to 1091.11., 1092. or 1094.;

1095. 2. Technology according to the General Technology Note for the "production" of equipment embargoed by 1091.1.c., 1091.4. to 1091.11. or 1092.;

NOTE:
"Development" or "production" technology embargoed by 1095. for gas turbine engines remains embargoed when used as "use" technology for repair, rebuild and overhaul.

Excluded from embargo are: technical data, drawings or documentation for maintenance activities directly associated with calibration, removal or replacement of damaged or unserviceable line replaceable units, including replacement of whole engines or engine modules.

(For technology for the repair of embargoed structures, laminates or materials, see 1015.2.f.)

1095. 3. Other technology, as follows:

a. Technology "required" for the "development" or "production" of the following gas turbine engine components or systems:

1. Directionally solidified gas turbine blades, vanes or tip shrouds rated to operate at gas path temperatures exceeding 1,593 K (1,320°C);

2. Single crystal blades, vanes or tip shrouds;

NOTE:
The technologies embargoed by 1095.3.a.1. and 2. will remain embargoed until the 30th November, 1992 unless the expiration date of the embargo period is extended.

3. Multiple domed combustors operating at average burner outlet temperatures exceeding 1,643 K (1,370° C), or combustors incorporating thermally decoupled combustion liners, non-metallic liners or non-metallic shells;

4. Components manufactured from organic "composite" materials designed to operate above 588 K (315° C), or from metal "matrix" "composite", ceramic "matrix", intermetallic or intermetallic reinforced materials embargoed by 1011.2. or 1013.7.;

5. Uncooled turbine blades, vanes, tip-shrouds or other components designed to operate at gas path temperatures of 1,323 K (1,050° C) or more;

6. Cooled turbine blades, vanes or tip-shrouds, other than those described in 1095.3.a.1. and 2., exposed to gas path temperatures of 1,643 K (1,370° C) or more;

7. Airfoil-to-disk blade combinations using solid state joining;

8. Gas turbine engine components using "diffusion bonding" technology embargoed by 1025.3.b.;

9. Damage tolerant gas turbine engine rotating components using powder metallurgy materials embargoed by 1013.2.b.;

10. FADEC for gas turbine and combined cycle engines and their related diagnostic components, sensors and specially designed components;

11. Adjustable flow path geometry and associated control systems for:

    a. Gas generator turbines;

    b. Fan or power turbines;

    c. Propelling nozzles;

    NOTES:
    1. Adjustable flow path geometry and associated control systems do not include inlet guide vanes, variable pitch fans, variable stators or bleed valves for compressors.

    2. 1095.3.a.11.does not embargo "development" or "production" technology for adjustable flow path geometry for reverse thrust.

12. Rotor blade tip clearance control systems employing active compensating casing technology limited to a design and development data base;

13. Gas bearings for gas turbine engine rotor assemblies;

14. Wide chord hollow fan blades without part-span support;

b. Technology "required" for the "development" or "production" of:

  1. Wind tunnel aero-models equipped with non-intrusive sensors capable of transmitting data from the sensors to the data acquisition system;
  2. "Composite" propeller blades or propfans capable of absorbing more than 2,000 kW at flight speeds exceeding Mach 0.55;

c. Technology "required" for the "development" or "production" of gas turbine engine components using "laser", water jet or ECM/EDM hole drilling processes to produce holes with:

  1. a. Depths more than four times their diameter;

     b. Diameters less than 0.76 mm; and

     c. Incidence angles equal to or less than 2; or

  2. a. Depths more than five times their diameter;

     b. Diameters less than 0.4 mm; and

     c. Incidence angles of more than 25°;

Technical Note:
For the purposes of 1095.3.c., incidence angle is measured from a plane tangential to the airfoil surface at the point where the hole axis enters the airfoil surface.

d. Technology "required" for the "development" or "production" of helicopter power transfer systems or tilt rotor or tilt wing "aircraft" power transfer systems:

  1. Capable of loss-of-lubrication operation for 30 minutes or more; or

  2. Having an input power-to-weight ratio equal to or more than 8.87 kW/kg.

e. 1. Technology for the "development" or "production" of reciprocating diesel engine ground vehicle propulsion systems having all of the following:

     a. A box volume of 1.2 m^3 or less;

b. An overall power output of more than 750 kW based on 80/1269/EEC, ISO 2534 or national equivalents; and

c. A power density of more than 700 kW/m³ of box volume;

Technical Note:
Box volume: the product of three perpendicular dimensions measured in the following way:

Length: The length of the crankshaft from front flange to flywheel face;

Width: The widest of the following:

a. The outside dimension from valve cover to valve cover;

b. The dimensions of the outside edges of the cylinder heads; or

c. The diameter of the flywheel housing;

Height: The largest of the following:

a. The dimension of the crankshaft centre-line to the top plane of the valve cover (or cylinder head) plus twice the stroke; or
b. The diameter of the flywheel housing.

1095. 3. e. 2. Technology "required" for the "production" of specially designed components, as follows, for high output diesel engines:

a. Technology "required" for the "production" of engine 2 systems having all of the following components employing ceramics materials embargoed by 1013.7:
1. Cylinder liners;

2. Pistons;

3. Cylinder heads; and

4. One or more other components (including exhaust ports, turbochargers, valve guides, valve assemblies or insulated fuel injectors);

- b. Technology "required" for the "production" of turbocharger systems, with single-stage compressors having all of the following:
  1. Operating at pressure ratios of 4:1 or higher;
  2. A mass flow in the range from 30 to 130 kg per minute; and
  3. Variable flow area capability within the compressor or turbine sections;
- c. Technology "required" for the "production" of fuel injection systems with a specially designed multifuel (e.g., diesel or jet fuel) capability covering a viscosity range from diesel fuel (2.5 cSt at 310.8 K (37.8° C)) down to gasoline fuel (0.5c St at 310.8 K (37.8° C)), having all of the following:
  1. Injection amount in excess of 230 mm^3 per injection per cylinder;
  2. Specially designed electronic control features for switching governor characteristics automatically depending on fuel property to provide the same torque characteristics by using the appropriate sensors;

3. Technology "required" for the "development" or "production" of high output diesel engines for solid, gas phase or liquid film (or combinations thereof) cylinder wall lubrication, permitting operation to temperatures exceeding 723 K (450° C), measured on the cylinder wall at the top limit of travel of the top ring of the piston.

Technical Note:

High output diesel engines:

Diesel engines with a specified brake mean effective pressure of 1.8 MPa or more at a speed of 2,300 r.p.m., provided the rated speed is 2,300 r.p.m. or more.

NOTE:
Governments may permit, as administrative exceptions, the shipment of marine gas turbine engines embargoed by 1091.2., for installation in civil marine vessels for civil end-use, provided their specific fuel consumption exceeds 0.23 kg/kWh and their continuous ISO rating is less than 20,000 kW.

STATEMENT OF UNDERSTANDING

It is understood that 1095.3.e.2.b. embargoes only technology "required" to achieve all of the parameters.

GROUP 2

COCOM INTERNATIONAL MUNITIONS LIST

2000. GENERAL TECHNOLOGY NOTE

Member Governments have determined to restrict the export of "technology" applicable to the "development", "production" and "use" of products as defined in the International Lists, including those subject to Administrative Exceptions Notes and those for which shipments are permitted without reporting to the Committee. This Note applies equally to "technology" specific to the integration or "use" of components in products as defined in the International List, even if the components themselves are unembargoed. "Technology" covered by this Note remains restricted even when applicable to the "development", "production" and "use" of an unembargoed product. This Note does not apply to that "technology" which is the minimum necessary for the installation, operation, maintenance (checking) and repair of those products whose export has been authorized. This Note does not apply to "technology" "in the public domain" or to "basic scientific research".

2001. Small arms and machine guns, as follows, and specially designed components therefor:

2001.a. Rifles, carbines, revolvers, pistols, machine pistols and machine guns, except antique small arms dated earlier than 1890 and their reproductions;

b. Smooth-bore weapons specially designed for military use;

c. Weapons using caseless ammunition;

Technical Note:
Smooth-bore weapons specially designed for military use as specified in sub-item (b) above are those which:

a. Are proof tested at pressures above 1,300 bars; and

b. Operate normally and safely at pressures above 1,000 bars; and

c. Are capable of accepting ammunition above 76.2 mm in length (e.g., commercial 12-gauge magnum shot gun shells).

The parameters in this Technical Note are to be measured according to the standards of the Permanent International Commission.

NOTES:

1. Governments may permit, as administrative exceptions, the shipment of weapons embargoed by this Item and specially designed components therefor, provided such weapons are not of the fully automatic firing type, as follows:

   a. Rifled-bore weapons specially designed for sporting target shooting as defined in the Olympic Rules;

   b. Rifled-bore weapons specially designed for hunting having a magazine capacity not exceeding 5 rounds;

   c. Multiple-barrelled hunting weapons having one or more rifled-bore barrel and at least one smooth-bore barrel;

   d. Clips or magazines for the above weapons with a capacity not exceeding 5 rounds; Prior to the issuance of a licence for weapons described in sub-paragraphs a. to d. of this Note, the Government of the exporting country will obtain from a responsible representative of the end-user or importing agency a signed statement describing the end-use and certifying that the weapons will not be re-exported or otherwise disposed of without the permission of the exporting country. Any licence issued by virtue of this Note shall be reported to the Committee at the time of licensing, together with a statement identifying the weapons being shipped, with information on the models, types and any specialised accessories or particular characteristics. The serial numbers of these weapons will be indicated at the time of shipment.

2. This Item does not embargo smooth-bore weapons used for hunting or sporting purposes. These weapons must not be specially designed for military use or of the fully automatic firing type.

3. This Item does not embargo firearms specially designed for dummy ammunition and which are incapable of firing any embargoed ammunition.

2002. Large calibre armament or weapons and projectors, as follows, and specially designed components therefor:

2002. a. Guns, howitzers, cannon, mortars, tank destroyers, projectile launchers, military flame throwers, recoilless rifles;

b. Military smoke, gas and pyrotechnic projectors or generators.

N.B.: This sub-item does not include signal pistols of the Very pistol type.

2003. Ammunition, and specially designed components therefor, for the weapons embargoed by Items 1, 2 or 26.

NOTES:

1. Specially designed components are understood to include:

   a. Metal or plastic fabrications such as primer anvils, bullet cups, cartridge links, rotating bands and munitions metal parts;

   b. Safing and arming devices, fuses, sensors and exploding bridge wire connectors;

   c. Power supplies with high one-time operational output;

   d. Combustible cases for charges;

   e. Submunitions including bomblets, minelets and terminally guided projectiles, except submunitions using a solely lead core.

2. This Item does not cover ammunition crimped without a projectile (blank star) and dummy ammunition with a pierced powder chamber.

3. Governments may permit, as administrative exceptions, the shipment of the following ammunition or cartridges, provided they are for weapons exportable as administrative exceptions under Note 1 to Item 2001:

   a. Target ammunition or cartridges with an expanding bullet of the type used for hunting or sport;

   b. Ammunition or cartridges specifically intended for the testing of firearms.

2004. Bombs, torpedoes, rockets and missiles, as follows, and specially designed components therefor:

a. Bombs, torpedoes, grenades (including smoke grenades), smoke canisters, rockets, mines, missiles, depth charges, fire bombs, incendiary bombs and military demolition charges, devices and kits, pyrotechnic flare signals for military use, cartridges and simulators;

b. Apparatus and devices specially designed for the handling, control, activation, powering with one-time operational output, launching, laying, sweeping, discharging, detonation or detection of items enumerated in sub-item a.;

c. Military fuel thickeners, including compounds (e.g., octal) or mixtures of such compounds (e.g., napalm) specifically formulated for the purpose of producing materials which, when added to petroleum products, provide a gel-type incendiary material for use in bombs, projectiles, flame throwers or other implements of war.

2005. Fire control systems and sub-systems, as follows, specially designed for military use, and specially designed components and accessories therefor:

2005. a. Fire control, gun laying, night sighting, missile tracking and guidance equipment and target surveillance equipment;

b. Range, position and height finders, spotting instruments, detection, recognition or identification equipment and sensors integration equipment;

c. Electronic, electro-optic, gyroscopic, acoustic and optical aiming or sighting devices;

d. Bomb sights, bombing computers, gun sights and periscopes.

2006. Vehicles, as follows, specially designed or modified for military use, and specially designed components therefor:

Technical Note:
For the purposes of this Item, the term 'specially modified for military use' means a structural, electrical or mechanical change which entails replacing a component with at least one specially designed military component, or adding at least one such component.

2006. a. Tanks and self-propelled guns;

b. Armed, armoured vehicles or vehicles fitted with mounting for arms;

c. Armoured railway trains;

d. Half-tracks;

e. Recovery vehicles;

f. Gun-carriers and tractors specially designed for towing artillery;

g. Ammunition trailers;

h. Amphibious and deep water fording vehicles;

i. Mobile repair shops specially designed to service military equipment;

j. All other vehicles specially designed or modified for military use.

NOTES:

1. Specially designed components for the equipment embargoed by this Item include:

   a. Pneumatic tyre casings of a kind specially constructed to be bullet-proof or to run when deflated, except types for agricultural and garden tractors and farm implements;

   b. Engines for the propulsion of the vehicles enumerated in sub-items a. to j., specially designed or modified for military use including specially designed components therefor;

   c. Tyre inflation pressure control systems, operated from inside a moving vehicle, specially designed or modified for military use;

   d. Large deflection suspensions specially designed or modified for military use.

2. Vehicles embargoed by sub-item j. include tank transporters, tracked amphibious cargo carriers, high speed tractors, heavy artillery transporters.

2007. Toxicological agents, tear gas, related equipment, components, materials and technology as follows:

2007. a. Biological agents, chemical agents or radioactive materials adapted for use in war to produce casualties in men or animals, or to damage crops;

b. "Tear gases" and "riot control agents" including:

   1. Bromobenzyl cyanide (CR);

2. oChlorobenzylidenemalononitrile (oChlorobenzalmalononitrile) (CS);

3. Phenylacyl chloride (w-chloroacetophenone) (CN);

c. Equipment specially designed and intended for the dissemination of the materials described in a.;

d. Equipment specially designed and intended for defence against the materials described in a. and for their detection and identification;

e. Components specially designed for the items listed in c. or d.;

f. "Biopolymers" specially designed or processed for detection and identification of chemical warfare (CW) agents described in a. and the cultures of specific cells used to produce them;

g. "Biocatalysts" for decontamination and degradation of CW agents, and biological systems therefor, as follows:

   1. "Biocatalysts", specially designed for decontamination and degradation of CW agents described in a. resulting from directed laboratory selection or genetic manipulation of biological systems;

   2. Biological systems, as follows: "expression vectors", viruses or cultures of cells containing the genetic information specific to the production of "biocatalysts" embargoed by g.1.;

h. Technology as follows:

   1. Technology for the development, production and use of toxicological agents, related equipment and components described in a. to e.;

   2. Technology for the development, production and use of "biopolymers" and cultures of specific cells described in f.;

   3. Technology exclusively for the incorporation of "biocatalysts", embargoed by g.1., into military carrier substances or military material.

NOTES:

1. Sub-item a. also embargoes:

   a. DF (methylphosphonyldifluoride);

   b. QL (O-ethyl-2-di-isopropylamino ethyl-methylphosphonite).

2. Sub-item d. includes air conditioning units specially designed or modified for nuclear, biological and chemical filtration.

3. Sub-item a. does not embargo:

   a. Cyanogen chloride;

   b. Hydrocyanic acid;

   c. Chlorine;

   d. Carbonyl chloride (phosgene);

   e. Diphosgene (trichloromethyl-chloroformate);

   f. Ethyl bromoacetate;

   g. Xylyl bromide;

   h. Benzyl bromide;

   i. Benzyl iodide;

   j. Bromo acetone;

   k. Cyanogen bromide;

   l. Bromo methylethylketone;

   m. Chloro acetone;

   n. Ethyl iodoacetate;

   o. Iodo acetone;

   p. Chloropicrine.

4. Sub-item d. does not embargo:

   a. Personal radiation monitoring dosimeters;

   b. Masks for protection against specific industrial hazards, such as fumes or powders in mining, quarrying and chemical plants; or

   c. Gas masks designed for civilian use.

5. The technology and cultures of cells for sub-item f. are exclusive and this sub-item does not embargo technology and cells for civil purposes, such as agricultural, pharmaceutical, medical, veterinary, environmental, and in the food industry.

6. The technology and biological systems listed in sub-items h.3. and g.2. are exclusive and these sub-items do not embargo technology and biological systems for civil purposes, such as agricultural, pharmaceutical, medical, veterinary, environmental, waste management, and in the food industry.

7. Government may permit, as administrative exceptions, the export of tear gas embargoed by sub-item b. provided the end use is stated to be civil and the quantities are considered by the Government of the exporting country to be reasonable and commensurate with the stated end use. Civilian use covers research, police activities and personal self defence.

8. Governments may permit, as administrative exceptions, the export of riot control agents embargoed by sub-item b. provided the end use is stated to be civil and the quantities are considered by the Government of the exporting country to be reasonable and commensurate with the stated end use. Civilian use covers research, police activities and personal self defence.

2008. Military explosives and fuels, as follows, and "additives", "precursors" and "stabilisers" therefor:

2008. a. "Military high explosives";

b. "Military propellants";

c. "Military pyrotechnics";

d. Military high-energy solid or liquid fuels, including aircraft fuels specially formulated for military purposes.

NOTE:
It is understood that this sub-item embargoes finished products only and does not embargo constituents.

NOTES:

1. "Military high explosives", "military propellants" and "military pyrotechnics" include substances and mixtures which contain any of the following:

   a. Spherical aluminium powder of particle size 60 micrometres or less manufactured from material with an aluminium content of 99% or more; For technology to achieve sphericity and uniform particle size, see also Category 1025.1.)
   b. Metal fuels in particle sizes less than 60 micrometres whether spherical, atomized, spheroidal, flaked or ground, manufactured from material consisting of 99% or more of any of the following: zirconium, boron, magnesium and alloys of these; beryllium; fine iron powder with average particle size of 3 micrometres or less produced by reduction of iron oxide with hydrogen;

   c. Perchlorates, chlorates and chromates composited with powdered metal or other high energy fuel components;

   d. Nitroguanidine (NQ);

   e. Compounds composed of fluorine and one or more of the following: other halogens, oxygen, nitrogen;

   f. Carboranes; decaborane; pentaborane and derivatives;

   g. Cyclotetramethylenetetranitramine (HMX); octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazine; 1,3,5,7-tetranitro-1,3,5,7-tetraza-cyclooctane; (octogen, octogene);

   h. Hexanitrostilbene (HNS);

   i. Diaminotrinitrobenzene (DATB);

   j. Triaminotrinitrobenzene (TATB);

   k. Triaminoguanidinenitrate (TAGN);

   l. Any explosive with a detonation velocity greater than 8,700 m/s or a detonation pressure greater than 340 kilobars;

   m. Other organic high explosives not listed in this Note yielding detonation pressures of 250 kilobars or greater that will remain stable at temperatures of 523 K (250° C) or higher for periods of 5 minutes or longer;

n. Titanium subhydride of stoichiometry TiH 0.65-1.68;

o. Dinitroglycoluril (DNGU, DINGU); tetranitroglycoluril (TNGU, SORGUYL);

p. Any other UN Class 1.1 solid propellant not listed in this Note with a theoretical specific impulse (under standard conditions) greater than 250 seconds for non-metallised, or greater than 270 seconds for aluminised compositions;

q. Any UN Class 1.3 solid propellant with a theoretical specific impulse greater than 230 seconds with non-halogenised, 250 seconds for non-metallised and 266 seconds for metallised compositions;

r. Tetranitrobenzotriazolobenzotriazole (TACOT);

s. Diaminohexanitrobiphenyl (DIPAM);

t. Picrylaminodinitropyridine (PYX);

u. 3-nitro-1,2,4-triazol-5-one (NTO or ONTA);

v. Hydrazine in concentrations of 70% or more; hydrazine nitrate; hydrazine perchlorates; unsymmetrical dimethyl hydrazine; monomethyl hydrazine; symmetrical dimetylhydrazine;

w. Ammonium perchlorate;

x. Cyclotrimethylenetrinitramine (RDX); cyclonite; T4; hexahydro-1,3,5-trinitro-1,3,5-triazine; 1,3,5-trinitro-1,3,5-triaza-cyclohexane; (hexogen, hexogene);

y. Hydroxylammonium nitrate (HAN); hydroxylammonium perchlorate (HAP);

z. Any other gun propellants not listed in this Note having a force constant greater than 1,200 kJ/kg;

aa. Any other explosive, propellant or pyrotechnic not listed in this Note that can sustain a steady-state burning rate greater than 38 mm per second under standard conditions of 68.9 bar pressure and 294 K (21° C);

bb. Elastomer modified cast double based propellants (EMCDB) with extensibility at maximum stress greater than 5% at 233 K (-40° C);

cc. Chemicals designed for propulsive loads:

   1. Propellant substances: Hydroxyl terminated polybutadiene (HTPB) with ferrocene additives such as butacene, having the following characteristics: Hydroxy index (Meq/g) less than 0.77; Viscosity (poise) less than 47; Functionality OH less than 2.16;

   2. Polymeric substances: Hydroxyl terminated polybutadiene (HTPB) having the following characteristics: Hydroxy index (Meq/g) less than 0.77; Viscosity (poise) less than 47; Functionality OH less than 2.16;

   3. All high yield fuels such as boron mixtures capable of releasing energy equal to or more than 40 x 10^{6} J/kg;

   4. Fuels or semi-propellants for ramjets and rocket-ramjets.

2. "Additives" include the following:

   a. Glycidylazide Polymer (GAP) and its derivatives;

   b. Polycyanodifluoroaminoethyleneoxide (PCDE);

   c. Butanetrioltrinitrate (BTTN);

   d. Bis-2-fluoro-2,2-dinitroethylformal (FEFO);

   e. Butadienenitrileoxide (BNO);

   f. Catocene, N-butyl-ferrocene and other ferrocene derivatives;

   g. Bis(2,2-dinitropropyl) formal and acetal;

   h. 3-nitraza-1,5-pentane diisocyanate;

   i. Energetic monomers, plasticisers and polymers containing nitro, azido, nitrate, nitraza or difluoroamino groups;

   j. 1,2,3-Tris[1,2-bis(difluoroamino)ethoxy] propane; Tris vinoxy propane adduct (TVOPA);

   k. Bisazidomethyloxetane and its polymers;

   l. Bischloromethyloxetane;

m. Polynitroorthocarbonates;

n. Tetraethylenepentamineacrylonitrile (TEPAN); cyanoethylated polyamine;

o. Tetraethylenepentamineacrylonitrileglycidol (TEPANOL); cyanoethylated polyamine adducted with glycidol;

p. Polyfunctional aziridine amides: with isophthalic, trimesic BITA or trimethyladipic backbone structures and 2-methyl or 2-ethyl substitutions on the aziridine ring;

q. Basic copper salicylate; lead salicylate;

r. Lead beta resorcylate;

s. Lead stannate, lead maleate, lead citrate;

t. Tris-1-(2-methyl)aziridinyl phosphine oxide (MAPO) and its derivatives;

u. Organo-metallic coupling agents, specifically: Neopentyl [diallyl] oxy, tri [dioctyl] phosphate titanate [titanium IV, 2,2[bis 2-propenolate-methyl, butanolate, tris [dioctyl] phosphate-O], LICA 12; Titanium IV, [(2-propenolate-1) methyl, N-propanolatomethyl] butanolate-1, tris[dioctyl]pyrophosphate, KR3538; Titanium IV, [(2-propenolato-1)methyl, N-propanolatemethyl] butanolate-1, tris(dioctyl)phosphate, KR3512.

3. "Precursors" include the following:

a. Guanidine nitrate;

b. 1,2,4 trihydroxybutane (1,2,4-butanetriol);

c. 1,3,5-trichlorobenzene;

d. Polynitroorthocarbonates;

e. Bischloromethyloxetane;

f. Low (less than 10,000) molecular weight, alcohol-functionalised, poly(epichlorohydrin); poly (epichlorohydrindiol);

g. Propylimine.

4. This Item does not embargo those "precursors" which are industrial chemicals, not embargoed elsewhere in the International Lists, widely available in international markets.

5. "Stabilisers" include N-Methyl-p-nitroaniline.

6. This Item does not embargo the following substances when not compounded or mixed with other "military high explosives" or powdered metals:

    a. Ammonium picrate;

    b. Black powder;

    c. Hexanitrodiphenylamine;

    d. Difluoroamine (HNF2);

    e. Nitrostarch;

    f. Potassium nitrate;

    g. Tetranitronaphthalene;

    h. Trinitroanisol;

    i. Trinitronaphthalene;

    j. Trinitroxylene;

    k. Fuming nitric acid;

    l. Trinitrophenylmethylnitramine (tetryl);

    m. Acetylene;

    n. Propane;

    o. Liquid oxygen;

    p. Hydrogen peroxide in concentrations of less than 85%;

    q. Misch metal;

    r. N-pyrrolidinone; 1-methyl-2-pyrrolidinone;

    s. Dioctylmaleate;

    t. Ethylhexylacrylate;

u. Triethylaluminium (TEA), trimethylaluminium (TMA), and other pyrophoric metal alkyls and aryls of lithium, sodium, magnesium, zinc and boron;

v. Nitrocellulose;

w. Nitroglycerin (or glyceroltrinitrate, trinitroglycerine) (NG);

x. 2,4,6-trinitrotoluene (TNT);

y. Ethylenediaminedinitrate (EDDN);

z. Pentaerythritoltetranitrate (PETN);

aa. Lead azide, normal and basic lead styphnate, and primary explosives or priming compositions containing azides or azide complexes;

bb. Triethyleneglycoldinitrate (TEGDN);

cc. 2,4,6-trinitroresorcinol (styphnic acid);

dd. Diethyldiphenyl urea; dimethylidiphenyl urea; methylethyldiphenyl urea [Centralites];

ee. N,N-diphenylurea (unsymmetrical diphenylurea);

ff. Methyl-N,N-diphenylurea (methyl unsymmetrical diphenylurea);

gg. Ethyl-N,N-diphenylurea (ethyl unsymmetrical diphenylurea);

hh. 2-Nitrodiphenylamine (2-NDPA);

ii. 4-Nitrodiphenylamine (4-NDPA);

jj. 2,2-dinitropropanol.

2009. Vessels of war and special naval equipment, as follows, and specially designed components therefor:

2009. a. Combatant vessels or vessels (surface or underwater) specially designed or modified for offensive or defensive action, whether or not converted to non-military use and regardless of current state of repair or operating condition, and hulls or parts of hulls for such vessels;

b. Engines, as follows:

  1. Diesel engines specially designed for submarines with both of the following characteristics:

    a. A power output of 1.12 MW (1,500 hp.) or more; and

    b. A rotary speed of 700 rev/min or more;

  2. Electric motors specially designed for submarines having all of the following characteristics:

    a. A power output of more than 0.75 MW (1,000 hp.);

    b. Quick reversing;

    c. Liquid cooled; and

    d. Totally enclosed;

  3. Non-magnetic diesel engines specially designed for military purposes with a power output of 37.3 kW (50 hp.) or more;

  NOTE:
  An engine shall be presumed to be specially designed for military purposes if:

    a. It has non-magnetic parts other than crankcase, block, head, pistons, covers, end plates, valve facings, gaskets, and fuel, lubrication and other supply lines; or

    b. Its non-magnetic content exceeds 75% of total mass;

    c. Underwater detection devices specially designed for military purposes and controls thereof;

    d. Submarine and torpedo nets;

    e. Compasses and equipment therefor and ship's course indicators, specially designed for submarines;

    f. Inertial navigation equipment for ships, including submersibles, with a navigation error (free inertial) equal to or less (better) than 0.8 nautical mile (50% Circular Error Probable (CEP)) in the first three hours subsequent to an alignment/calibration period of one day;

g. Hull penetrators and connectors specially designed for military purposes that enable interaction with equipment external to a vessel;

NOTE:
This sub-item includes: Connectors for vessels which are of the single-conductor, multi-conductor, coaxial or waveguide type, and hull penetrators for vessels, both of which are capable of remaining impervious to leakage from without and of retaining required characteristics at marine depths exceeding 100 m; and fibre-optic connectors regardless of depth. It does not include: ordinary propulsive shaft and hydrodynamic control-rod hull penetrators.

h. Silent bearings specially designed for military purposes and equipment containing those bearings.

2010. Aircraft and helicopters, unmanned airborne vehicles, aero-engines and aircraft or helicopter equipment, associated equipment and components, specially designed for military purposes, as follows:

2010. a. Combat aircraft and helicopters and other aircraft and helicopters specially designed for military purposes, including military reconnaissance, assault, military training and logistic support, and all aircraft and helicopters having special structural features such as multiple hatches, special doors, ramps and reinforced floors, for transporting and airdropping troops, military equipment and supplies, and specially designed components therefor;

b. Aero-engines specially designed or adapted for use with aircraft and helicopters embargoed by sub-item (a) above, except aero-engines not embargoed by Category 1091.1., and specially designed components therefor;

c. Unmanned airborne vehicles, including remotely piloted air vehicles (RPVs), and autonomous, programmable vehicles specially designed or modified for military purposes and their launchers, ground support and associated equipment for command and control;

d. Airborne equipment, including airborne refuelling equipment, specially designed for use with the aircraft and helicopters and the aero-engines embargoed by sub-items a. and b. above, and specially designed components therefor;

e. Pressure refuellers, pressure refuelling equipment, equipment specially designed to facilitate operations in confined areas and ground equipment, developed specially for aircraft and helicopters embargoed by sub-item a. above, or for aero-engines embargoed by sub-item b. above;

f. Pressurised breathing equipment and partial pressure suits for use in aircraft and helicopters, anti-g suits, military crash helmets and protective masks, liquid oxygen converters used for aircraft, helicopters and missiles, catapults and cartridge actuated devices utilised in emergency escape of personnel from aircraft and helicopters;

g. Parachutes used for combat personnel, cargo dropping and aircraft deceleration, as follows:

  1. Parachutes for:

    a. Pin point dropping of rangers;
    b. Dropping of paratroopers;

  2. Cargo parachutes;

  3. Paragliders (drag parachutes, drogue parachutes for stabilisation and attitude control of dropping bodies, e.g., recovery capsules, ejection seats, bombs);

  4. Drogue parachutes for use with ejection seat systems for deployment and inflation sequence regulation of emergency parachutes;

  5. Recovery parachutes for guided missiles, drones and space vehicles;

  6. Approach parachutes and landing deceleration parachutes;

  7. Other military parachutes;

h. Automatic piloting systems for parachuted loads; equipment specially designed or modified for military purposes for controlled opening jumps at any height, including oxygen equipment.

2011. Electronic equipment specially designed for military use and specially designed components therefor.

NOTE:
This Item includes:

a. Jamming and counter-jamming equipment, including electronic counter measure (ECM) and electronic counter-counter measure (ECCM) apparatus (i.e., apparatus designed to introduce extraneous or erroneous signals into radar or radio communication receivers or otherwise hinder the reception, operation or effectiveness of adversary electronic receivers including their counter measure equipment);

b. Frequency agile tubes;

c. Electronic systems or equipment designed either for surveillance and monitoring of the electro-magnetic spectrum for military intelligence or security purposes or for counteracting such surveillance and monitoring;

d. Underwater counter measure, including acoustic and magnetic jamming and decoy, equipment designed to introduce extraneous or erroneous signals into sonar receivers;

e. Data processing security equipment, data security equipment and transmission and signalling line security equipment, using ciphering processes;

f. Identification, authentication and keyloader equipment and key management, manufacturing and distribution equipment.

2012. Photographic and electro-optical imaging equipment, as follows, and specially designed components therefor:

2012. a. Air reconnaissance cameras and associated equipment designed for military purposes;

b. Film processing and printing machines designed for military purposes;

c. Other cameras and electro-optical imaging devices, including infrared and imaging radar sensors, whether recording, or transmitting via data link, designed for military, including reconnaissance, purposes;

d. Specialised equipment for the cameras and electro-optical imaging devices embargoed by sub-item c. above designed to make the recorded or transmitted information militarily useful.

NOTE:
Specialised equipment embargoed by sub-item d. above which relates to electro-optical imaging devices and imaging radar sensors includes digital image processors and softcopy imagery display devices.

(See also Item 2015.)

2013. Special armoured equipment, as follows:

2013. a. Armoured plate;
b. Combinations and constructions of metallic and non-metallic materials specially designed to provide ballistic protection for military systems;
c. Military helmets;
d. Body armour, flak suits and specially designed components therefor.

NOTES:

1. Sub-item b. includes combinations of metallic and non-metallic materials specially designed to form explosive reactive armour.

2. Sub-item c. does not embargo conventional steel helmets not equipped with, modified or designed to accept any type of accessory device.

2014. Specialised equipment for military training or for simulating military scenarios, specially designed components and accessories therefor.

NOTES:

1. The term 'specialised military training equipment' includes military types of attack trainers, operational flight trainers, radar target trainers, radar target generators, gunnery training devices, anti-submarine warfare trainers, flight simulators (including human-rated centrifuges for pilot/astronaut training), radar trainers, instrument flight trainers, navigation trainers, target equipment, drone aircraft, armament trainers, pilotless aircraft trainers and mobile training units.

2. This Item includes synthetic image generating systems (SIG) for simulators when specially designed or modified for military purposes.

2015. Military infrared, thermal imaging and image intensifier equipment, and specially designed components therefor.

(See also Category 1061.2.a.2. and 1061.2.b.)

NOTES:

1. This Item includes infrared jamming and counter jamming equipment (i.e., apparatus designed to introduce extraneous or erroneous signals into infrared seeking missiles, infrared surveillance systems, thermal imaging equipment and infrared communication links or otherwise hinder the operation or effectiveness of military infrared systems) including their counter measure equipment.

2. The term 'specially designed components' includes the following when specially designed for military use:

   a. Infrared image converter tubes;

   b. Image intensifier tubes;

   c. Microchannel plates;

   d. Low-light-level television camera tubes;

   e. Infrared detector arrays;

   f. Pyroelectric television camera tubes;

   g. Cryogenic coolers used in military thermal imaging systems.

2016. Forgings, castings and semi-finished products specially designed for the products embargoed by Items 1., 2., 3., 4., 6. or 10. on this List.

NOTE:
This Item includes artillery material, machine guns, automatic weapons and small arms.

2017. Miscellaneous equipment and materials, as follows, and specially designed components therefor:

2017. a. Self-contained diving and underwater swimming apparatus, as follows:

1. Closed and semi-closed circuit (rebreathing) apparatus;

2. Specially designed components for use in the conversion of open-circuit apparatus to military use;

3. Articles exclusively designed for military use with self-contained diving and underwater swimming apparatus;

b. Firearms silencers (mufflers);

c. Power-controlled searchlights and control units therefor, designed for military use;

d. Construction equipment built to military specifications, specially designed for airborne transport;

e. External fittings, coatings and treatments for the suppression of acoustic, radar, infrared and other emissions, specially designed for military use;

f. Field engineer equipment specially designed for use in a combat zone;

g. "Robots", "robot" controllers and "robot" "end-effectors", having any of the following characteristics:

1. Specially designed for military applications;

2. Incorporating means of protecting hydraulic lines against externally induced punctures caused by ballistic fragments (e.g., incorporating self-sealing lines) and designed to use hydraulic fluids with flash points higher than 839 K (566° C);

3. Operable at altitudes exceeding 30,000 m; or

4. Specially designed or rated for operating in an electro-magnetic pulse (EMP) environment.

2018. Equipment and technology for the "production" of products referred to in this List, as follows:

2018. a. Specially designed or modified "production" equipment for the production of products embargoed by this List, and specially designed components therefor;

b. Specially designed environmental test facilities and specially designed equipment therefor, for the certification, qualification, or testing of products embargoed by this List;

c. Specific "production" technology, even if the equipment with which such technology is to be used is unembargoed;

d. Technology specific to the design of, the assembly of components into, and the operation, maintenance and repair of complete "production" installations even if the components themselves are unembargoed.

NOTES:

1. Sub-item a. above includes the following equipment:
   - a. Nitrators: continuous types;
   - b. Centrifugal testing apparatus or equipment having any of the following characteristics:
     - 1. Driven by a motor or motors having a total rated horsepower greater than 298 kW (400 hp);
     - 2. Capable of carrying a payload of 113 kg or more;
     - 3. Capable of exerting a centrifugal acceleration of 8 g or more on a payload of 91 kg or more;
   - c. Dehydration presses;
   - d. Extrusion presses for the extrusion of small arms, cannon and rocket propellants;
   - e. Cutting machines for the sizing of extruded propellants;
   - f. Sweetie barrels (tumblers) 1.85 m and over in diameter and having over 227 kg product capacity;
   - g. Continuous mixers for solid propellants.
2. a. The terms 'products referred to in this List' include:
   - 1. Products not embargoed if inferior to specified concentrations as follows:
     - a. Hydrazine (see Note 1v. to Item 8);
     - b. "Military high explosives" (see Item 8);

2. Products not embargoed if inferior to technical limits, i.e., "superconductive" materials not embargoed by 1023.5.;"superconductive" electromagnets not embargoed by 1031.1.e.3;"superconductive" electrical equipment excluded from embargo under Item 20 b.

b. The terms 'products referred to in this List' exclude:

   1. Signal pistols of the Very type (see Item 2.b.);

   2. Tractor and farm implement type pneumatic tyre casings (see Note 1 to Item 6);

   3. The substances excluded from embargo under Note 3 to Item 7;

   4. Personal radiation monitoring dosimeters and masks for protection against specific industrial hazards (see Note 4 to Item 7);

   5. Acetylene, propane, liquid oxygen, difluoramine (HNF_2), fuming nitric acid and potassium nitrate powder (see Note 6 to Item 8);

   6. Aero-engines excluded from embargo under Item 10 by reference to aero-engines not embargoed by 1091.1.;

   7. Conventional steel helmets not equipped with, modified or designed to accept, any type of accessory device (see Note 2 to Item 13);

   8. Equipment fitted with unembargoed industrial machinery, such as coating machinery not elsewhere specified and equipment for the casting of plastics;

   9. Antique small arms dating back beyond the year 1890, and their reproductions. (This listing does not allow the export of technology or production equipment for non-antique small arms, even if used to produce reproductions of antique small arms.)

3. Sub-item d. above does not include technology for civil purposes, such as agricultural, pharmaceutical, medical, veterinary and environmental, and in the food industry (see Note 5 to Item 7.).

4. Governments may permit, as administrative exceptions, the shipment of equipment used to determine the safety data of explosives, as required by the International Convention on the Transport of Dangerous Goods (C.I.M) articles 3 and 4 in Annex I RID, provided Governments are satisfied that such equipment will be used only by the railway authorities of current C.I.M. members, or by Government-accredited testing facilities in those countries, for the testing of explosives to transport safety standards, as follows:

    a. Equipment for determining ignition and deflagration temperatures;

    b. Equipment for steel-shell tests;

    c. Drop hammers not exceeding 20 kg in mass for determining the sensitivity of explosives to shock;

    d. Equipment for determining the friction sensitivity of explosives when exposed to charges not exceeding 36 kg in mass.

2020. Cryogenic and "superconductive" equipment, as follows, and specially designed components and accessories therefor:

2020. a. Equipment specially designed or configured to be installed in a vehicle for military ground, marine, airborne or space application and capable of operating while in motion and of producing or maintaining temperatures below 103 K (-170° C);

b. "Superconductive" electrical equipment (rotating machinery and transformers) specially designed or configured to be installed in a vehicle for military ground, marine, airborne or space applications and capable of operating while in motion, except direct-current hybrid homopolar generators that have single-pole normal metal armatures which rotate in a magnetic field produced by superconducting windings, provided those windings are the only superconducting component in the generator.

2022. Electrically triggered shutters of photochromic or electro-optical type having a shutter speed of less than 100 microseconds, except shutters which are an essential part of a high-speed camera.

2023. Directed energy weapons (DEW) systems and specially designed components, as follows:

2023. a. "Laser" systems specially designed for destruction or effecting mission-abort of a target;

b. Particle beam systems capable of destruction or effecting mission-abort of a target;

c. High power radio-frequency (RF) systems capable of destruction or effecting mission-abort of a target;

d. Specially designed components for systems embargoed by sub-items a., b. or c. above, including:

1. Prime power generation, energy storage, switching, power conditioning and fuel-handling equipment;

2. Target acquisition and tracking subsystems;

3. Subsystems capable of assessing target damage, destruction or mission-abort;

4. Beam-handling, propagation and pointing equipment;

5. Equipment with rapid beam slew capability for rapid multiple target operations;

6. Adaptive optics;

7. Current injectors for negative hydrogen ion beams which provide average injection currents over 50 mA with beam brightness (defined as current divided by the product of orthogonal transverse, normalised root mean square emittances) greater than 40 A/(cm2.mrad2) at kinetic energies of more than 20 keV; or

8. Specially designed components for the equipment embargoed by 1. to 7. above;

e. Equipment specially designed for the detection and identification of, and defence against, systems embargoed by sub-items a., b. or c. above, and specially designed components therefor;

f. Physical test models and related documentation for the systems, equipment and components described in sub-items a. to e. above.

(For the embargo parameters of "lasers" or associated "laser" components, see Category 1041.5.)

NOTE:
Directed energy weapons embargoed by this Item include systems whose capability is derived from the controlled application of:

a. "Lasers" of sufficient continuous wave or pulsed power to effect destruction similar to the manner of conventional ammunition;

b. Particle accelerators which project a charged or neutral particle beam with destructive power;

c. High pulsed power or high average power radio frequency beam transmitters which produce fields sufficiently intense to disable electronic circuitry at a distant target.

2024. "Software", as follows:

2024. a. "Software" specially designed or modified for the "development", "production" or "use" of equipment or materials embargoed by this List;

b. Specific "software", as follows:

1. "Software" specially designed for:

    a. Development, monitoring, maintenance or updating of "software" embedded in military weapon systems;

    b. Modelling or simulating military operation scenarios, not embargoed by Item 2014;

    c. Command, Communications, Control and Intelligence (C^{3}I) applications;

2. "Software" for determining the effects of conventional, nuclear, chemical or biological warfare weapons.

2026. Kinetic energy weapon systems and associated equipment, as follows, and specially designed components therefor:

2026. a. Kinetic energy weapons systems specially designed for destruction or effecting mission-abort of a target;

b. Specially designed test and evaluation facilities and test models, including diagnostic instrumentation and targets, for dynamic testing of kinetic energy projectiles and systems;

c. Specially designed subsystems for systems embargoed by a. or b. above, including:

1. Launch-propulsion-subsystems capable of accelerating masses larger than 0.1 g to velocities in excess of 1.6 km/s in single or rapid fire modes;

2. Prime power generation, energy storage, thermal management, conditioning, switching and fuel-handling equipment;

3. Target acquisition, tracking, fire control and damage assessment subsystems;

4. Homing seeker, guidance and divert propulsion (lateral acceleration) subsystems for projectiles.

NOTES:

1. Weapon systems using sub-calibre ammunition and employing solely chemical propulsion are embargoed by Items 2001, 2002 or 2003 with respect to the ammunition.

2. c. 2. does not embargo technology for magnetic induction for continuous propulsion of civil transport devices.

3. This Item embargoes systems using any of the following methods of propulsion:

   a. Electromagnetic;

   b. Electrothermal;

   c. Plasma;

   d. Light gas; or

   e. Chemical (when used in combination with any of the above).

GROUP 3

COCOM INTERNATIONAL ATOMIC ENERGY LIST

3000. GENERAL TECHNOLOGY NOTE

Member Governments have determined to restrict the export of "technology" applicable to the "development", "production" and "use" of products as defined in the International Lists, including those subject to Administrative Exceptions Notes and those for which shipments are permitted without reporting to the Committee.

This Note applies equally to "technology" specific to the integration or "use" of components in products as defined in the International List, even if the components themselves are unembargoed.

"Technology" covered by this Note remains restricted even when applicable to the "development", "production" and "use" of an unembargoed product.

This Note does not apply to that "technology" which is the minimum necessary for the installation, operation, maintenance (checking) and repair of those products whose export has been authorized.

This Note does not apply to "technology" "in the public domain" or to "basic scientific research".

A. NUCLEAR MATERIALS

Technical Notes:

1. Raw materials
   The embargo on raw materials covers all materials from which the metal can be usefully extracted, i.e., ores, concentrates, matte, regulus, residues and dross (ashes).

2. Metals and alloys
   Unless provision to the contrary is made, the words 'metals' and 'alloys' cover crude and semi-fabricated forms, as follows: Crude forms: Anodes, balls, bars (including notched bars and wire bars), billets, blocks, blooms, brickets, cakes, cathodes, crystals, cubes, dice, grains, granules, ingots, lumps, pellets, pigs, powder, rondelles, shot, slabs, slugs, sponge, sticks;
   Semi-fabricated forms (whether or not coated, plated, drilled or punched):

a. Wrought or worked materials fabricated by rolling, drawing, extruding, forging, impact extruding, pressing, graining, atomising, and grinding, i.e.: angles, channels, circles, discs, dust, flakes, foils and leaf, forging, plate, powder, pressings and stampings, ribbons, rings, rods (including bare welding rods, wire rods, and rolled wire), sections, shapes, sheets, strip, pipe and tubes (including tube rounds, squares, and hollows), drawn or extruded wire;

b. Cast material produced by casting in sand, die, metal, plaster or other types of moulds, including high pressure castings, sintered forms, and forms made by powder metallurgy.

The object of the embargo should not be defeated by the export of non-listed forms alleged to be finished products but representing in reality crude forms or semi-fabricated forms.

3001."Special and other fissile materials", except:

3001. a. Shipments of one "effective gramme" or less;

b. Shipments of three "effective grammes" or less when contained in a sensing component in instruments.

NOTE:
Governments may permit, as administrative exceptions, the shipment of enriched uranium in which the assay of uranium 235 is less than 20% in the form of nuclear reactor fuel supplied subsequently for use in exported reactors which meet all the provisions of Note 2 to Item 3103.

3002. Natural and depleted uranium, in any form or incorporated in any substance in which the concentration of uranium exceeds 0.05% by weight, except:

3002. a. Shipments having a natural uranium content of:

1. 10 kg or less for any application; or

2. 100 kg or less for civil non-nuclear applications;

b. Uranium depleted in the isotope 235 in which the uranium 235 isotope comprises less than 0.35% of the total uranium assay;

c. Depleted uranium specially fabricated for the following civil applications:

   1. Shielding;

   2. Packaging;

   3. Ballasts;

   4. Counter-weights.

NOTES:

1. Governments may permit, as administrative exceptions, the shipment of uranium for the purpose of its enrichment in the isotope 235 (toll enrichment), provided:

   a. Any uranium enriched in the isotope 235 is removed from proscribed countries upon completion of the enrichment process; and

   b. Any depleted uranium (tails) resulting from the enrichment process will be removed from proscribed countries unless the assay of the uranium 235 isotope remaining in the depleted uranium is 0.35% or less.

2. Governments may permit, as administrative exceptions,'the shipment of uranium in the form of nuclear reactor fuel supplied subsequently for use in exported reactors which meet all of the provisions of Note 2 to Item 3103.

(For titanium-uranium alloys, see Category 1013.4.)

3003. Deuterium, heavy water, deuterated paraffins, and simple or complex lithium deuterides, and mixtures and solutions containing deuterium, in which the isotopic ratio of deuterium to hydrogen exceeds 1:5,000, except shipments of the above having a deuterium content of 10 kg or less.

NOTE:
Governments may permit, as administrative exceptions, subsequent shipments of deuterium oxide (D_2O), for use in exported reactors meeting all the provisions of Note 2 to Item 3103.

3004. Zirconium metal; alloys containing more than 50% zirconium by weight; compounds in which the ratio of hafnium to zirconium is less than 1:500 parts by weight; and manufactures wholly thereof; except:

3004. a. Zirconium metal, alloys and compounds in shipments of 5 kg or less;

b. Zirconium in the form of foil or strip having a thickness not exceeding 0.10 mm, in shipments of 200 kg or less.

NOTE:
Governments may permit, as administrative exceptions, for use in exported civil power reactors meeting all of the provisions of Note 2 to Item 3103. or for use in identified civil research reactors, the shipment of:

a. Parts made of zirconium metal or alloys, specially designed for those reactors, such as cladding tubes and plugs and separators therefor, liner tubes, thermal insulating tubes, pressure tubes and calandria tubes, provided none of the parts contain fissile material;

b. Zirconium metal or alloys, in individual shipments not exceeding 100 kg, when intended for use in, or in support of, these reactors.

3005. Nickel powder and porous nickel metal, as follows:

3005. a. Powder with a nickel purity content of 99.9% or more and a mean particle size of less than 10 micrometres measured by the ASTM B 330 standard and a high degree of particle size uniformity;

b. Porous nickel metal produced from materials embargoed by a. above except single porous nickel metal sheets not exceeding 930 cm^2 intended for use in batteries for civil applications.

NOTES:

1. Sub-item b. above refers to porous nickel metal manufactured from nickel powder defined in sub-item a. above which has been compacted and sintered to form a metal material with fine pores interconnected throughout the structure.

2. Governments may permit, as administrative exceptions, the shipment for non-nuclear civil applications of nickel powder in uncompacted powder form.

3006. Nuclear-grade graphite, i.e., graphite having a purity level of less than one part per million boron equivalent and with a density greater than 1.5 g/cm^3, except individual shipments of 100 kg or less.

3007. Lithium, as follows:

3007. a. Metal, hydrides or alloys containing lithium enriched in the 6 isotope to a concentration higher than the one existing in nature (7.5% on an atom percentage basis);

b. Any other materials containing lithium enriched in the 6 isotope (including compounds, mixtures and concentrates), except lithium enriched in the 6 isotope incorporated in thermoluminescent dosimeters.

(For the deuteride of natural lithium or of lithium enriched in the 6 isotope, see Item 3003.)

3008. Hafnium, as follows: metal, alloys and compounds of hafnium containing more than 60% hafnium by weight, and manufactures thereof, except shipments of the above having a hafnium content of 1 kg or less.

3009. Beryllium, as follows: metal, alloys containing more than 50% beryllium by weight, compounds containing beryllium and manufactures thereof, except:

3009. a. Metal windows for X-ray machines;

b. Oxide shapes in fabricated or semi-fabricated forms specially designed for electronic component parts or as substrates for electronic circuits;

c. Shipments of 500 g or less of beryllium having a purity of 99% or less, or 100 g or less of beryllium having a purity of greater than 99%, provided shipments exclude single crystals;

d. Shipments of 5 kg or less of beryllium contained in compounds with a purity of less than 99%.

3012. Tritium, compounds and mixtures containing tritium in which the ratio of tritium to hydrogen by atoms exceeds 1 part in 1,000, and products containing one or more of the foregoing, except:

3012. a. Shipments of tritium, compounds, mixtures and individual products containing one or more of the foregoing substances not exceeding 100 curies;

b. Tritium contained in luminous paint, self-luminous products, gas and aerosol detectors, electron tubes, lightning or static elimination devices, ion generating tubes, detector cells of gas chromatography devices, and calibration standards;

c. Compounds and mixtures of tritium, where the separation of the constituents cannot result in the evolution of an isotopic mixture of hydrogen in which the ratio of tritium to hydrogen by atoms exceeds 1 part in 1,000.

3013. Materials for nuclear heat sources, as follows:

3013. a. Plutonium in any form with a plutonium isotopic assay of plutonium-238 of more than 50%, except:

1. Shipments with a plutonium content of one gramme or less;

2. Shipments of three effective grammes or less when contained in a sensing component in instruments;

3. Plutonium-238 contained in heart pacemakers;

b. "Previously separated" neptunium-237 in any form, except shipments with a neptunium-237 content of one gramme or less.

3015. Wet-proofed platinized catalysts specially designed or prepared for promoting hydrogen isotope exchange between hydrogen and water for the recovery of tritium from heavy water or for heavy water production.

B. NUCLEAR FACILITIES

3101. Plants for the separation of isotopes of natural and depleted uranium, special and other fissile materials, and specially designed or prepared equipment and components therefor, as follows:

3101. a. Plants specially designed for separating isotopes of natural anddepleted uranium, special and other fissile materials, as follows:

1. Gaseous diffusion separation plants;
2. Gas centrifuge separation plants;
3. Aerodynamic separation plants;
4. Chemical exchange separation plants;
5. Ion-exchange separation plants;
6. Atomic vapour "laser" isotopic separation plants;
7. Molecular "laser" isotopic separation plants;
8. Plasma separation plants;
9. Electromagnetic separation plants;

b. Equipment and components, as follows, specially designed or prepared for:

1. Gaseous diffusion separation process:
    - a. Valves wholly made of or lined with aluminium, aluminium alloys, nickel or alloy containing 60% or more nickel, 40 mm or more in diameter, with bellows seals;
    - b. Blowers and compressors (turbo, centrifugal and axial flow types) wholly made of or lined with aluminium, aluminium alloys, nickel or alloy containing 60% or more nickel and having a capacity of 1,700 litres (1.7 m^3) per minute or more including compressor seals;
    - c. Gaseous diffusion barriers made of porous metallic, polymer or ceramic materials resistant to corrosion by UF6 with a pore size of less than 1,000 angstroms, a thickness of 5 mm or less, and, for tubular forms, a diameter of 25 mm or less;

d. Gaseous diffuser housings;

e. Heat exchangers made of aluminium, copper, nickel or alloys containing more than 60% nickel, or combinations of these metals as clad tubes, designed to operate at sub-atmospheric pressure with a leak rate that limits the pressure rise to less than 10 pascal (0.1 millibar) per hour under a pressure differential of 10^5 pascal (1 bar);

2. Gas centrifuge separation process:

a. Gas centrifuges;

b. Complete rotor assemblies;

c. Rotor tube cylinders with a thickness of 12 mm or less, a diameter of between 75 mm and 400 made from high strength-to-density ratio materials described in the Note below;

d. Magnetic suspension bearings consisting of an annular magnet suspended within a housing containing a damping medium. The magnet couples with a pole piece or second magnet fitted to the top cap of the rotor;

e. Specially prepared bearings comprising a pivot-cup assembly mounted on a damper;

f. Rings or bellows with a wall thickness of 3 mm or less and a diameter of between 75 mm and 400 mm and designed to give local support to a rotor tube or to join a number together, made from high strength-to-density ratio materials described in the Note below;

g. Baffles of between 75 mm and 400 mm diameter for mounting inside the rotor tube, made from high strength-to-density ratio materials described in the Note below;

h. Top and bottom caps of between 75 mm and 400 mm diameter to fit the ends of the rotor tube, made from high strength-to-density ratio materials described in the Note below;

i. Molecular pumps comprised of cylinders having internally machined or extruded helical grooves and internally machined bores;

j. Ring-shaped motor stators for multiphase AC hysteresis (or reluctance) motors for synchronous operation within a vacuum in the frequency range of 600 to 2,000 Hz and a power range of 50 to 1,000 Volt-Amps;

k. Frequency changers (converters or inverters) specially designed or prepared to supply motor stators for gas centrifuge enrichment, having all of the following characteristics, and specially designed components therefor:

   1. Multiphase output of 600 Hz to 2 kHz;

   2. Frequency control better than 0.1%;

   3. Harmonic distortion of less than 2%; and

   4. An efficiency greater than 80%;

NOTE:
The high strength-to-density ratio materials used for centrifuge rotating components are:

a. Maraging steel capable of an ultimate tensile strength of 2.05×10^9 N/m^2 or more;

b. Aluminium alloys capable of an ultimate tensile strength of 0.46×10^9 N/m^2 or more;

c. "Fibrous and filamentary materials" with a "specific modulus" of more than 3.18×10^6 m and a "specific tensile strength" greater than 7.62×10^4 m.

3. Aerodynamic separation process:

   a. Separation nozzles consisting of slit-shaped, curved channels having a radius of curvature less than 1 mm.
   Contained within the nozzle is a knife-edge which separates gas flowing through the nozzle into two streams;

   b. Tangential inlet flow-driven cylindrical or conical tubes, specially designed for uranium isotope separation;

   c. UF6-hydrogen helium compressors wholly made of or lined with aluminium, aluminium alloys, nickel or alloy containing 60% or more nickel, including compressor seals;

d. Aerodynamic separation element housing, designed to contain vortex tubes or separation nozzles;

e. Heat exchangers made of aluminium, copper, nickel, or alloys containing more than 60% nickel, or combinations of these metals as clad tubes, designed to operate at pressures of 6×10^5 pascal (6 bar) or less;

4. Chemical exchange separation process:

a. Fast-exchange liquid-liquid centrifugal contactors or fast exchange liquid-liquid pulse columns made of fluorocarbon lined materials;

b. Electrochemical reduction cells designed to reduce uranium from one valence state to another;

5. Ion-exchange separation process, including fast reacting ion-exchange resins: pellicular, reticulated resins in which the active chemical exchange groups are limited to a coating on the surface of an inert particle or fibre;

6. Atomic vapour "laser" isotopic separation process:

a. High power electron beam guns with total power of more than 50 kW and strip or scanning electron beam guns with a delivered power of more than 2.5 kW/cm for use in uranium vaporization systems;

b. Trough shaped crucible and cooling equipment for molten uranium;

c. Product and tails collector systems made of or lined with materials resistant to the heat and corrosion of uranium vapour, such as yttria-coated graphite;

N.B.: The "lasers" and components, specified as follows, are important in atomic vapour "laser" isotopic separation:

(For the embargo status of "lasers", see Category 1061.5.)

a. "Lasers" to pump dye "lasers":

1. Copper vapour "lasers" of 40 W or more;

2. Argon ion "lasers" of more than 40 W;

3. ND:YAG "lasers" that can be frequency doubled and thereby have an average power of more than 40 W;

b. Other "lasers" and accessories:

1. "Tunable" pulsed dye "laser" amplifiers and oscillators, except single-mode oscillators, with an average power of more than 30 W, a repetition rate of more than 1 kHz and a wavelength between 500 nm and 700 nm;

2. Modulators for controlling and modifying dye "laser" bandwidth;

3. "Tunable" pulsed single-mode dye oscillators capable of an average power of more than 1 W, a repetition rate of more than 1 KHz, a pulse width less than 100 ns, a wavelength between 500 nm and 700 nm and frequency modulation for bandwidth expansion.

7. Molecular "laser" isotopic separation process:

a. Para-hydrogen Raman shifters designed to operate at 16 micrometres output wavelength and at a repetition rate of more than 250 Hz;

b. Supersonic expansion nozzles designed for UF6 carrier gas;

c. Uranium fluoride (UF5) product filter collectors;

d. Equipment for fluorinating UF5 to UF6;

e. UF6 carrier gas compressors wholly made of or lined with aluminium, aluminium alloys, nickel or alloy containing 60% or more nickel, including compressor seals;

N.B.: The "lasers", specified as follows, are important in molecular "laser" isotopic separation:

(For the embargo status of "lasers", see Category 1061.5.)

a. Alexandrite "lasers" with a bandwidth of 0.005 nm (3 GHz) or less, a repetition rate of more than 125 Hz, and an average power of more than 30 W;

b. Pulsed carbon dioxide "lasers" with a repetition rate of more than 250 Hz, an average power of more than 1.2 kW and a pulse length less than 200 ns;

c. Pulsed excimer "lasers" (XeF, XeCl, KrF) with a repetition rate of more than 250 Hz and an average power of more than 250 W;

8. Plasma separation process:

a. Product and tails collectors made of or lined with materials resistant to the heat and corrosion of uranium vapour such as yttria-coated graphite;

b. Radio frequency ion excitation coils for frequencies of more than 100 kHz and capable of handling more than 40 kW power;

N.B.: Microwave power sources and superconductive electromagnets, specified as follows, are important in the plasma separation process:

(For the embargo status of microwave power sources, see Category 1031.1.b.)

(For the embargo status of "superconductive" electromagnets, see Category 1031.1.e.3.)

a. Microwave power sources of more than 30 GHz and greater than 50 kW for ion production;

b. Solenoidal superconductive electromagnets of more than 30 cm inner diameter, with a magnetic field of more than 2 T and uniform to better than 1% over the central 80% of the inner volume;

9. UF6 mass spectrometers/ion sources specially designed or prepared for taking on-line samples of feed, product or tails from UF6 gas streams and having all of the following characteristics:

a. Unit resolution for mass of more than 320;

b. Ion sources constructed of or lined with nichrome or monel, or nickel plated;

c. Electron bombardment ionization sources; and

d. Collector systems suitable for isotopic analysis.

3102. Plants for the reprocessing of irradiated nuclear reactor fuel elements, and specially designed or prepared equipment and components therefor, including:

3102. a. Fuel element chopping or shredding machines, i.e., remotely operated equipment to cut,chop,shred or shear irradiated nuclear reactor fuel assemblies, bundles or rods;

b. Criticality safe tanks (e.g., small diameter, annular or slab tanks) specially designed or prepared for the dissolution of irradiated nuclear reactor fuel, which are capable of withstanding hot, highly corrosive liquids, and which can be remotely loaded and maintained;

c. Counter-current solvent extractors and ion-exchange processing equipment specially designed or prepared for use in a plant for the reprocessing of irradiated natural uranium, depleted uranium or special and other fissile materials;

d. Process control instrumentation specially designed or prepared for monitoring or controlling the reprocessing of irradiated source and special and other fissile materials.

NOTE:
A plant for the reprocessing of irradiated nuclear reactor fuel elements includes equipment and components which normally come into direct contact with and directly control the irradiated fuel and the major nuclear material and fission product processing streams.

3103. Nuclear reactors, i.e., reactors capable of operation so as to maintain a controlled, self-sustaining fission chain reaction, and equipment and components specially designed or prepared for use in connection with a nuclear reactor, including:

3103. a. Pressure vessels, i.e., metal vessels as complete units or as major shop-fabricated parts therefor, which are specially designed or prepared to contain the core of a nuclear reactor and are capable of withstanding the operating pressure of the primary coolant, including the top plate for a reactor pressure vessel;

b. Fuel element handling equipment, including reactor fuel charging and discharging machines;

c. Control rods, i.e., rods specially designed or prepared for the control of the reaction rate in a nuclear reactor, including the neutron absorbing part and the support or suspension structures therefor, and control rod guide tubes;

d. Electronic controls for controlling the power levels in nuclear reactors, including reactor control rod drive mechanisms and radiation detection and measuring instruments to determine neutron flux levels;

e. Pressure tubes, i.e., tubes specially designed or prepared to contain fuel elements and the primary coolant in a nuclear reactor at an operating pressure in excess of 50 bars (atmospheres);

f. Coolant pumps, i.e., pumps specially designed or prepared for circulating the primary coolant of nuclear reactors;

g. Internals specially designed or prepared for the operation of a nuclear reactor, including but not limited to core support structures, thermal shields, baffles, core grid plates and diffuser plates;

h. Heat exchangers.

NOTES:

Governments may permit, as administrative exceptions, the shipment of water-cooled and moderated civil nuclear power reactors, including major components therefor and initial shipments of fuel and moderators therefor, provided:

a. The reactor is designed to use uranium fuel of 20% or less enrichment;

b. Fuel to be provided shall be uranium of 20% or less enrichment;

c. The reactor is not designed for marine propulsion. (For "software", see Item 3301.)

3104. Plants specially designed for the fabrication of nuclear reactor fuel elements and specially designed equipment therefor.

NOTE:
A plant for the fabrication of nuclear reactor fuel elements includes equipment which:

a. Normally comes into direct contact with or directly processes or controls the production flow of nuclear materials;

b. Seals the nuclear material within the cladding;

c. Checks the integrity of the cladding or the seal; and

d. Checks the finish treatment of the solid fuel.

3105. Plants for the production of heavy water, deuterium or deuterium compounds, and specially designed or prepared equipment and components therefor, as follows:

3105. a. Plants for the production of heavy water, deuterium or deuterium compounds, as follows:
  1. Hydrogen sulphide-water exchange plants;
  2. Ammonia-hydrogen exchange plants;
  3. Hydrogen distillation plants;

b. Equipment and components, as follows, specially designed or prepared for:

  1. Hydrogen sulphide-water exchange process:
     a. Tray exchange towers;
     b. Hydrogen sulphide gas compressors;
  2. Ammonia-hydrogen exchange process:
     a. High-pressure ammonia-hydrogen exchange towers;
     b. High-efficiency stage contactors;
     c. Submersible stage recirculation pumps;
     d. Ammonia crackers designed for pressures of more than 3×10^6 pascal (30 bar);

3. Hydrogen distillation process:

   a. Hydrogen cryogenic distillation towers and cold boxes designed for operation below 35 K;

   b. Turboexpanders or turboexpander-compressor sets designed for operation below 35 K;

4. Concentration of heavy water to reactor grade (99.75% deuterium oxide):

   a. Water distillation towers containing specially designed packings;

   b. Ammonia distillation towers containing specially designed packings;

   c. Catalytic burners for conversion of fully enriched deuterium to heavy water;

   d. Infrared absorption analysers capable of on-line hydrogen-deuterium ratio analysis where deuterium concentrations are equal to or more than 90 %.

3106. Plants for the production of uranium hexafluoride (UF6) and specially designed or prepared equipment and components therefor, as follows:

3106. a. Plants for the production of UF6 ;

b. Equipment and components, as follows, specially designed or prepared for UF6 production:

   1. Fluorination and hydrofluorination screw and fluid bed reactors and flame towers;

   2. Distillation equipment for the purification of UF6.

C. NUCLEAR-RELATED EQUIPMENT

3201. Neutron generator systems, including tubes, designed for operation without an external vacuum system and utilising electrostatic acceleration to induce a tritium-deuterium nuclear reaction.

NOTE:
Governments may permit, as administrative exceptions, the shipment of tubes and systems covered by this Item, provided:

a. They are for civil use;

b. The Government of the exporting country has previously submitted details of such equipment to the Committee, who have agreed that it should be eligible for administrative exception treatment. The Committee shall reach a final decision on each application within 45 days of the receipt of a detailed data sheet, including a complete technical description. Questions may be raised up to the 30th day inclusive and the 45-day period will be suspended from the time when questions are raised until answers are received thereto.

N.B.: The following tubes and systems, specifically described in the documents referenced below and with the characteristics set forth therein and in the accompanying brochures, are eligible for administrative exception treatment under this Note:

Neutron generator tube type 18600
(See Doc. 4215.58/5)

Elliot Hiletron fast neutron radio therapy equipment

Elliot P type neutron generator and corresponding tube
(See Docs. (72) AEL.40/1 and 6)

Kaman Nuclear A-711 neutron generator system
(See Docs. (72) 2353 and DEF. (73) AEL.40/1)

Kaman A-710 neutron generator
(See Doc. DEF. (77) AEL.40/1).

3202. Power generating or propulsion equipment specially designed for use with military, space, marine or mobile nuclear reactors.

NOTES:

1. This Item does not apply to conventional power generating equipment which, although designed for use in a particular nuclear station, could in principle be used in conjunction with conventional systems.

2. Each Government will use its discretion in determining whether or not power generating or propulsion equipment is specially designed for military, space, marine or mobile use.

3203. Electrolytic cells for the production of fluorine with a production capacity greater than 250 g of fluorine per hour.

3204. Equipment, as follows, specially designed or prepared for the separation of isotopes of lithium:

3204. a. Packed liquid-liquid exchange columns specially designed for lithium amalgams;

b. Amalgam pumps;

c. Amalgam electrolysis cells;

d. Evaporators for concentrated lithium hydroxide solution.

3205. Equipment specially designed for the production or recovery of tritium.

D. "SOFTWARE"

3301. "Software" specially designed or modified for the "development", "production" or "use" of equipment or materials embargoed by this List.

NOTE:
Governments may permit, as administrative exceptions, the shipment of embargoed "software" for:

a. Monitoring or enhancing the safety of water-cooled or moderated civil nuclear reactors; or

N.B.: This sub-paragraph permits the export of training simulators designed for nuclear power plants but does not permit the export of any design or development information for the nuclear reactor.

b. Monitoring or reducing releases from such reactors or plants into the environment.

DEFINITIONS OF TERMS USED IN THE COCOM INTERNATIONAL LISTS

"Accuracy"

(Usually measured in terms of inaccuracy.) The maximum deviation, positive or negative, of an indicated value from an accepted standard or true value.

"Active flight control systems"

Function to prevent undesirable "aircraft" and missile motions or structural loads by autonomously processing outputs from multiple sensors and then providing necessary preventive commands to effect automatic control.

"Active pixel"

A minimum (single) element of the solid state array which has a photoelectric transfer function when exposed to light (electromagnetic) radiation.

"Adaptive control"

A control system that adjusts the response from conditions detected during the operation (Ref. ISO 2806-1980).

"Additives"

Substances used in explosive formulations to improve their properties.

"Aircraft"

A fixed wing, swivel wing, rotary wing (helicopter), tilt rotor or tilt-wing airborne vehicle. (See also "civil aircraft".)

"Angular position deviation"

The maximum difference between angular position and the actual, very accurately measured angular position after the workpiece mount of the table has been turned out of its initial position (Reference: VDI/VDE 2617, Draft: "Rotary tables on coordinate measuring machines").

"Antibodies"

See "Anti-idiotypic antibodies" "Monoclonal antibodies" "Polyclonal antibodies".

"Anti-idiotypic antibodies"

Antibodies which bind to the specific antigen binding sites of other antibodies.

"Assembly"

A number of electronic components (i.e., "circuit elements", "discrete components", integrated circuits, etc.) connected together to perform (a) specific function(s), replaceable as an entity and normally capable of being disassembled.

N.B.:

1. "Circuit element": a single active or passive functional part of an electronic circuit, such as one diode, one transistor, one resistor, one capacitor, etc.
2. "Discrete component": a separately packaged "circuit element" with its own external connections.

"Asynchronous transfer mode" (ATM)

A transfer mode in which the information is organized into cells; it is asynchronous in the sense that the recurrence of cells depends on the required or instantaneous bit rate (CCITT Recommendation L.113).

"Automatic target tracking"

A processing technique that automatically determines and provides as output an extrapolated value of the most probable position of the target in real time.

"Bandwidth of one voice channel"

In the case of data communication equipment designed to operate in one voice channel of 3,100 Hz, as defined in CCITT Recommendation G.151.

"Basic gate propagation delay time"

The propagation delay time value corresponding to the basic gate used within a "family" of "monolithic integrated circuits". This may be specified, for a given "family", either as the propagation delay time per typical gate or as the typical propagation delay time per gate.

N.B.: "Basic gate propagation delay time" is not to be confused with the input/output delay time of a complex "monolithic integrated circuit".

"Basic scientific research"

Experimental or theoretical work undertaken principally to acquire new knowledge of the fundamental principles of phenomena or observable facts, not primarily directed towards a specific practical aim or objective.

"Beat length"

The distance over which two orthogonally polarized signals, initially in phase, must pass in order to achieve a 2 Pi radian(s) phase difference.

"Bias" (accelerometer)

An accelerometer output when no acceleration is applied.

"Biocatalysts"

"Enzymes" or other biological compounds which bind to and accelerate the degradation of CW agents.

N.B. "Enzymes": "Biocatalysts" for specific chemical or biochemical reactions.

"Biopolymers"

Biological macromolecules as follows:

a. "Enzymes";
b. Antibodies, "monoclonal", "polyclonal" or "anti-idiotypic";
c. Specially designed or specially processed "receptors";

N.B. "Enzymes": "Biocatalysts" for specific chemical or biochemical reactions.

"Camming" (axial displacement)

Axial displacement in one revolution of the main spindle measured in a plane perpendicular to the spindle faceplate, at a point next to the circumference of the spindle faceplate (Reference: ISO 230/1 1986, paragraph 5.63).

"Chemical Laser"

A "laser" in which the excited species is produced by the output energy from a chemical reaction.

"Circulation-controlled anti-torque or circulation controlled direction control systems"

Use air blown over aerodynamic surfaces to increase or control the forces generated by the surfaces.

"Civil aircraft"

Those "aircraft" listed by designation in published airworthiness certification lists by the civil aviation authorities to fly commercial civil internal and external routes or for legitimate civil, private or business use. (See also "aircraft".)

"Commingled"

Filament to filament blending of thermoplastic fibres and reinforcement fibres in order to produce a fibre reinforcement/ "matrix" mix in total fibre form.

"Comminution"

A process to reduce a material to particles by crushing or grinding.

"Common channel signalling"

A signalling method in which a single channel between exchanges conveys, by means of labelled messages, signalling information relating to a multiplicity of circuits or calls and other information such as that used for network management.

"Communications channel controller"

The physical interface which controls the flow of synchronous or asynchronous digital information. It is an assembly that can be integrated into computer or telecommunications equipment to provide communications access.

"Composite"

A "matrix" and an additional phase or additional phases consisting of particles, whiskers, fibres or any combination thereof, present for a specific purpose or purposes.

"Composite theoretical performance" (CTP)

A measure of computational performance given in millions of theoretical operations per second (Mtops), calculated using the aggregation of "computing elements" (CE). (See Category 1040 Technical Note.)

"Compound rotary table"

A table allowing the workpiece to rotate and tilt about two non-parallel axes, which can be coordinated simultaneously for "contouring control".

"Computer using facility"

The end-user's contiguous and accessible facilities:

a. Housing the "computer operating area" and those end-user functions which are being supported by the stated application of the electronic computer and its related equipment; and

b. Not extending beyond 1,500 metres in any direction from the centre of the "computer operating area".

N.B.: "Computer operating area": the immediate contiguous and accessible area around the electronic computer, where the normal operating, support and service functions take place.

"Computing element" (CE)

The smallest computational unit that produces an arithmetic or logic result.

"Contouring control"

Two or more "numerically controlled" motions operating in accordance with instructions that specify the next required position and the required feed rates to that position. These feed rates are varied in relation to each other so that a desired contour is generated (Ref. ISO/DIS 2806-1980).

"Conventional unguided projectiles"

Are those which do not incorporate:

a. Directional warheads, including warheads employing multi-point initiation to achieve focused blast/fragmentation characteristics;

b. Sub-munitions or sub-munition capacity;

c. Fuel/air explosives;

d. Provisions for increasing the range or impact velocity;

e. Kinetic energy armour penetration capability;

f. Mid-flight guidance;

g. Terminal guidance.

"Critical temperature"

(Sometimes referred to as the transition temperature) of a specific "superconductive" material is the temperature at which the material loses all resistance to the flow of direct electrical current.

"Cryptanalysis"

The analysis of a cryptographic system or its inputs and outputs to derive confidential variables or sensitive data, including clear text (ISO 7498-2-1988(E), paragraph 3.3.18).

"Cryptography"

The discipline which embodies principles, means and methods for the transformation of data in order to hide its information content, prevent its undetected modification or prevent its unauthorized use. "Cryptography" is limited to the transformation of information using one or more "secret parameters" (e.g., crypto variables) or associated key management.

N.B.: "Secret parameter": a constant or key kept from the knowledge of others or shared only within a group.

"Datagram"

A self-contained, independent entity of data carrying sufficient information to be routed from the source to the destination data terminal equipment without reliance on earlier exchanges between this source or destination data terminal equipment and the transporting network.

"Data signalling rate"

The rate, as defined in ITU Recommendation 53-36, taking into account that, for non-binary modulation, baud and bit per second are not equal. Bits for coding, checking and synchronisation functions are to be included.

N.B.: 1. When determining the "data signalling rate", servicing and administrative channels shall be excluded.

N.B.: 2. It is the maximum one-way rate, i.e., the maximum rate in either transmission or reception.

"Deformable Mirrors"

Mirrors capable of having their optical surface dynamically deformed by individual torques or forces.

"Development"

Is related to all stages prior to serial production, such as design, design research, design analyses, design concepts, assembly and testing of prototypes, pilot production schemes, design data, process of transforming design data into a product, configuration design, integration design, layouts.

"Diffusion bonding"

A solid state molecular joining of at least two separate metals into a single piece with a joint strength equivalent to that of the weakest material.

"Digital computer"

Equipment which can, in the form of one or more discrete variables:

a. Accept data;

b. Store data or instructions in fixed or alterable (writable) storage devices;

c. Process data by means of a stored sequence of instructions which is modifiable; and

d. Provide output of data.

N.B.: Modifications of a stored sequence of instructions include replacement of fixed storage devices, but not a physical change in wiring or interconnections.

"Digital transfer rate"

The total bit rate of the information that is directly transferred on any type of medium.

(See also "total digital transfer rate".)

"Direct-acting hydraulic pressing"

A deformation process which uses a fluid-filled flexible bladder in direct contact with the workpiece.

"Drift rate" (gyro)

The time rate of output deviation from the desired output. It consists of random and systematic components and is expressed as an equivalent input angular displacement per unit time with respect to inertial space.

"Dynamic adaptive routing"

Automatic rerouting of traffic based on sensing and analysis of current actual network conditions.

N.B.: This does not include cases of routing decisions taken on predefined information.

"Dynamic signal analysers"

"Signal analysers" which use digital sampling and tranformation techniques to form a Fourier spectrum display of the given waveform including amplitude and phase information.

(See also "signal analysers".)

"Effective gramme"

Of special or other fissile material is defined as follows:

a. For plutonium isotopes and uranium-233, the isotope weight in grammes;

b. For uranium enriched 1% or greater in the isotope U-235, the element weight in grammes multiplied by the square of its enrichment expressed as a decimal weight fraction;

c. For uranium enriched below 1% in the isotope U-235, the element weight in grammes multiplied by 0.0001;

d. For americium-242m, curium-245 and -247, and californium -249 and -251, the isotope weight in grammes multiplied by 10.

"Electronically steerable phased array antenna"

An antenna which forms a beam by means of phase coupling, i.e., the beam direction is controlled by the complex excitation coefficients of the radiating elements and the direction of that beam can be varied in azimuth or in elevation, or both, by application, both in transmission and reception, of an electrical signal.

"End-effectors"

"End-effectors" include grippers, "active tooling units" and any other tooling that is attached to the baseplate on the end of a "robot" manipulator arm.

N.B.: "Active tooling unit": a device for applying motive power, process energy or sensing to the workpiece.

"Equivalent Density"

The mass of an optic per unit optical area projected onto the optical surface.

"Expert systems"

Systems providing results by application of rules to data which are stored independently of the "programme" and capable of any of the following:

a. Modifying automatically the "source code" introduced by the user;

b. Providing knowledge linked to a class of problems in quasi-natural language; or

c. Acquiring the knowledge required for their development (symbolic training).

"Expression Vectors"

Carriers (e.g., plasmid or virus) used to introduce genetic material into host cells.

"Family"

Consists of microprocessor or microcomputer microcircuits with:

a. The same architecture;

b. The same basic instruction set; and

c. The same basic technology (e.g., only NMOS or only CMOS).

"Fast select"

A facility applicable to virtual calls which allows a data terminal equipment to expand the possibility to transmit data in call set-up and clearing "packets" beyond the basic capabilities of a virtual call.

N.B.: "Packet": a group of binary digits including data and call control signals which is switched as a composite whole. The data, call control signals and possibly error control information are arranged in a specified format.

"Fault tolerance"

The capability of a computer system, after any malfunction of any of its hardware or "software" components, to continue to operate without human intervention, at a given level of service that provides: continuity of operation, data integrity and recovery of service within a given time.

"Fibrous or filamentary materials" Include:

a. Continuous monofilaments;

b. Continuous yarns and rovings;

c. Tapes, fabrics, random mats and braids;

d. Chopped fibres, staple fibres and coherent fibre blankets;

e. Whiskers, either monocrystalline or polycrystalline, of any length;

f. Aromatic polyamide pulp.

"Film type integrated circuit"

An array of "circuit elements" and metallic interconnections formed by deposition of a thick or thin film on an insulating "substrate".

N.B.: Circuit element": a single active or passive functional part of an electronic circuit, such as one diode, one transistor, one resistor, one capacitor, etc.

"Fixed"

The coding or compression algorithm cannot accept externally supplied parameters (e.g., cryptographic or key variables) and cannot be modified by the user.

"Flexible manufacturing unit" (FMU),
(sometimes also referred to as 'flexible manufacturing system' (FMS) or 'flexible manufacturing cell' (FMC)) An entity which includes a combination of at least:

a. A "digital computer" including its own "main storage" and its own related equipment; and

b. Two or more of the following:

    1. A machine tool described in 1022.1.c.;

2. A dimensional inspection machine described in 1020., or another digitally controlled measuring machine embargoed by 1020.;

3. A "robot" embargoed by 1020., 1080. or 2017.;

4. Digitally controlled equipment embargoed by 1012.3., 1022.3. or 1092.1.;

5. "Stored programme controlled" equipment embargoed by 1032.1.a.;

6. Digitally controlled equipment embargoed by 1012.1.;

7. Digitally controlled electronic equipment embargoed by 1031.2.c.

"Fluoride fibres"

Fibres manufactured from bulk fluoride compounds.

"Frequency agility" (frequency hopping)

A form of "spread spectrum" in which the transmission frequency of a single communication channel is made to change by discrete steps.

"Frequency switching time"

The maximum time (i.e., delay), taken by a signal, when switched from one selected output frequency to another selected output frequency, to reach:

a. A frequency within 100 Hz of the final frequency; or

b. An output level within 1 dB of the final output level.

"Frequency synthesiser"

Any kind of frequency source or signal generator, regardless of the actual technique used, providing a multiplicity of simultaneous or alternative output frequencies, from one or more outputs, controlled by, derived from or disciplined by a lesser number of standard (or master) frequencies.

"Gas Atomisation"

A process to reduce a molten stream of metal alloy to droplets of 500 micrometre diameter or less by a high pressure gas stream.

"Gateway"

The function, realised by any combination of equipment and "software", to carry out the conversion of conventions for representing, processing or communicating information used in one system into the corresponding but different conventions used in another system.

"Generic software"

A set of instructions for a "stored programme controlled" switching system that is the same for all switches using that type of switching system.

N.B.: The data base portion is not considered to be part of the "generic software".

"Geographically dispersed"

Sensors are considered "geographically dispersed" when each location is distant from any other more than 1,500 m in any direction. Mobile sensors are always considered "geographically dispersed".

"Global interrupt latency time"

The time taken by the computer system to recognize an interrupt due to the event, service the interrupt and perform a context switch to an alternate memory-resident task waiting on the interrupt.

"Hot isostatic densification"

A process of pressurising a casting at temperatures exceeding 375 K (102C) in a closed cavity through various media (gas, liquid, solid particles, etc.) to create equal force in all directions to reduce or eliminate internal voids in the casting.

"Hybrid computer"

Equipment which can:

a. Accept data;

b. Process data, in both analogue and digital representations; and

c. Provide output of data.

"Hybrid integrated circuit"

Any combination of integrated circuit(s), or integrated circuit with "circuit elements" or "discrete components" connected together to perform (a) specific function(s), and having all of the following characteristics:

Containing at least one unencapsulated device;

Connected together using typical IC production methods;

Replaceable as an entity; and

Not normally capable of being disassembled.

N.B.: 1. "Circuit element": a single active or passive functional part of an electronic circuit, such as one diode, one transistor, one resistor, one capacitor, etc. 2. "Discrete component": a separately packaged "circuit element" with its own external connections.

"Image enhancement"

The processing of externally derived information-bearing images by algorithms such as time compression, filtering, extraction, selection, correlation, convolution or transformations between domains (e.g., fast Fourier transform or Walsh transform). This does not include algorithms using only linear or rotational transformation of a single image, such as translation, feature extraction, registration or false coloration.

"Information security"

All the means and functions ensuring the accessibility, confidentiality or integrity of information or communications, excluding the means and functions intended to safeguard against malfunctions. This includes "cryptography", "cryptanalysis", protection against compromising emanations and computer security.

"Instantaneous bandwidth"

The bandwidth over which output power remains constant within 3 dB without adjustment of other operating parameters.

"Instrumented range"

The specified unambiguous display range of a radar.

"Integrated Services Digital Network" (ISDN)

A unified end-to-end digital network, in which data originating from all types of communication (e.g., voice, text, data, still and moving pictures) are transmitted from one port (terminal) in the exchange (switch) over one access line to and from the subscriber.

"Interconnected radar sensors"

Two or more radar sensors are interconnected when they mutually exchange data in real time.

"In the public domain"

Means "technology" or "software" which has been made available without restrictions upon its further dissemination.

N.B.: Copyright restrictions do not remove "technology" or "software" from being "in the public domain".

"Intrinsic Magnetic Gradiometer"

A single magnetic field gradient sensing element and associated electronics the output of which is a measure of magnetic field gradient.

(See also "Magnetic Gradiometer")

"Isostatic presses"

Equipment capable of pressurising a closed cavity through various media (gas, liquid, solid particles, etc.) to create equal pressure in all directions within the cavity upon a workpiece or material.

"Laser"

An assembly of components which produce both spatially and temporally coherent light that is amplified by stimulated emission of radiation.

"Linearity"

(Usually measured in terms of non-linearity) is the maximum deviation of the actual characteristic (average of upscale and downscale readings), positive or negative, from a straight line so positioned as to equalise and minimise the maximum deviations.

"Local area network"

A data communication system which:

a. Allows an arbitrary number of independent "data devices" to communicate directly with each other; and

b. Is confined to a geographical area of moderate size (e.g., office building, plant, campus, warehouse).

N.B.: "Data device": equipment capable of transmitting or receiving sequences of digital information.

"Magnetic Gradiometers"

Are designed to detect the spatial variation of magnetic fields from sources external to the instrument. They consist of multiple "magnetometers" and associated electronics the output of which is a measure of magnetic field gradient.

"Magnetometers"

Are designed to detect magnetic fields from sources external to the instrument. They consist of a single magnetic field sensing element and associated electronics the output of which is a measure of the magnetic field.

"Main storage"

The primary storage for data or instructions for rapid access by a central processing unit. It consists of the internal storage of a "digital computer" and any hierarchical extension thereto, such as cache storage or non-sequentially accessed extended storage.

"Matrix"

A substantially continuous phase that fills the space between particles, whiskers or fibres.

"Maximum bit transfer rate"

Of a disk drive or solid state storage device: the number of data bits per second transferred between the drive or the device and its controller.

"Measurement uncertainty"

The characteristic parameter which specifies in what range around the output value the correct value of the measurable variable lies with a confidence level of 95 %. It includes the uncorrected systematic deviations, the uncorrected backlash and the random deviations (Reference: VDI/VDE 2617).

"Mechanical Alloying"

An alloying process resulting from the bonding, fracturing and rebonding of elemental and master alloy powders by mechanical impact. Non-metallic particles may be incorporated in the alloy by addition of the appropriate powders.

"Media access unit"

Equipment which contains one or more communication interfaces ("network access controller", "communications channel controller", modem or computer bus) to connect terminal equipment to a network.

"Melt Extraction"

A process to "solidify rapidly" and extract a ribbon-like alloy product by the insertion of a short segment of a rotating chilled block into a bath of a molten metal alloy.

N.B.: "Solidify rapidly": solidification of molten material at cooling rates exceeding 1,000 K/sec.

"Melt Spinning"

A process to "solidify rapidly" a molten metal stream impinging upon a rotating chilled block, forming a flake, ribbon or rod-like product.

N.B.: "Solidify rapidly": solidification of molten material at cooling rates exceeding 1,000 K/sec.

"Microcomputer microcircuit"

A "monolithic integrated circuit" or "multichip integrated circuit" containing an arithmetic logic unit (ALU) capable of executing general purpose instructions from an internal storage, on data contained in the internal storage.

N.B.: The internal storage may be augmented by an external storage.

"Microprocessor microcircuit"

A "monolithic integrated circuit" or "multichip integrated circuit" containing an arithmetic logic unit (ALU) capable of executing a series of general purpose instructions from an external storage.

N.B.: The "microprocessor microcircuit" normally does not contain integral user-accessible storage, although storage present on-the-chip may be used in performing its logic function.

"Microprogramme"

A sequence of elementary instructions, maintained in a special storage, the execution of which is initiated by the introduction of its reference instruction into an instruction register.

"Military high explosives"

Solid, liquid or gaseous substances or mixtures of substances which, in their application as primary, booster, or main charges in warheads, demolition and other military applications, are required to detonate.

"Military propellants"

Solid, liquid or gaseous substances or mixtures of substances used for propelling projectiles and missiles, or to generate gases for powering auxiliary devices for embargoed military equipment which, when ignited, burn or deflagrate to produce quantities of gas capable of performing work, but in their application these quantities are required not to undergo a deflagration to detonation transition.

"Military pyrotechnics"

Mixtures of solid or liquid fuels and oxidizers which, when ignited, undergo an energetic chemical reaction at a controlled rate intended to produce specific time delays, or quantities of heat, noise, smoke, visible light or infrared radiation.
Pyrophorics are a subclass of pyrotechnics, which contain no oxidizers but ignite spontaneously on contact with air.

"Monoclonal antibodies"

Proteins which bind to one antigenic site and are produced by a single clone of cells.

"Monolithic integrated circuit"

A combination of passive or active "circuit elements" or both which:

- a. Are formed by means of diffusion processes, implantation processes or deposition processes in or on a single semiconducting piece of material, a so-called 'chip';
- b. Can be considered as indivisibly associated; and
- c. Perform the function(s) of a circuit.

N.B.: "Circuit element": a single active or passive functional part of an electronic circuit, such as one diode, one transistor, one resistor, one capacitor, etc.

"Most immediate storage"

The portion of the "main storage" most directly accessible by the central processing unit:

- a. For single level "main storage", the internal storage; or
- b. For hierarchical "main storage":
  - 1. The cache storage;
  - 2. The instruction stack; or
  - 3. The data stack.

"Motion control board"

An electronic "assembly" specially designed to provide a computer system with the capability to coordinate simultaneously the motion of axes of machine tools for "contouring control".

"Multichip integrated circuit"

Two or more "monolithic integrated circuits" bonded to a common "substrate".

"Multi-data-stream processing"

The "microprogramme" or equipment architecture technique which permits simultaneous processing of two or more data sequences under the control of one or more instruction sequences by means such as:

a. Single Instruction Multiple Data (SIMD) architectures such as vector or array processors;

b. Multiple Single Instruction Multiple Data (MSIMD) architectures;

c. Multiple Instruction Multiple Data (MIMD) architectures, including those which are tightly coupled, closely coupled or loosely coupled; or

d. Structured arrays of processing elements, including systolic arrays.

"Multilevel security"

A class of system containing information with different sensitivities that simultaneously permits access by users with different security clearances and needs-to-know, but prevents users from obtaining access to information for which they lack authorization.

N.B.: "Multilevel security" is computer security and not computer reliability which deals with equipment fault prevention or human error prevention in general.

"Multispectral imaging sensors"

Are capable of simultaneous or serial acquisition of imaging data from two or more discrete spectral bands. Sensors having more than twenty discrete spectral bands are sometimes referred to as hyperspectral imaging sensors.

"Network access controller"

A physical interface to a distributed switching network. It uses a common medium which operates throughout at the same "digital transfer rate" using arbitration (e.g., token or carrier sense) for transmission. Independently from any other, it selects data packets or data groups (e.g., IEEE 802) addressed to it. It is an assembly that can be integrated into computer or telecommunications equipment to provide communications access.

"Neural computer"

A computational device designed or modified to mimic the behaviour of a neuron or a collection of neurons, i.e., a computational device which is distinguished by its hardware capability to modulate the weights and numbers of the interconnections of a multiplicity of computational components based on previous data.

"Noise level"

An electrical signal given in terms of power spectral density. The relation between "noise level" expressed in peak-to-peak is given by S 2 pp = 8No(f2-f1), where Spp is the peak-to-peak value of the signal (e.g., nanoteslas), No is the power spectral density (e.g., (nanotesla)2/Hz) and (f2-f1) defines the bandwidth of interest.

"Nuclear reactor"

Includes the items within or attached directly to the reactor vessel, the equipment which controls the level of power in the core, and the components which normally contain or come into direct contact with or control the primary coolant of the reactor core.

"Numerical control"

The automatic control of a process performed by a device that makes use of numeric data usually introduced as the operation is in progress (Ref. ISO 2382).

"Object code" (or object language)

An equipment executable form of a convenient expression of one or more processes ("source code" (or source language)) which has been converted by a programming system. (See also "source code").

"Operate autonomously"

Fully submerged, without snorkel, all systems working and cruising at minimum speed at which the submersible can safely control its depth dynamically by using its depth planes only, with no need for a support vessel or support base on the surface, sea-bed or shore, and containing a propulsion system for submerged or surface use.

"Optical amplification"

In optical communications, an amplification technique that introduces a gain of optical signals that have been generated by a separate optical source, without conversion to electrical signals, i.e., using semiconductor optical amplifiers, optical fibre luminescent amplifiers.

"Optical computer"

A computer designed or modified to use light to represent data and whose computational logic elements are based on directly coupled optical devices.

"Optical fibre preforms"

Bars, ingots, or rods of glass, plastic or other materials which have been specially processed for use in fabricating optical fibres. The characteristics of the preform determine the basic parameters of the resultant drawn optical fibres.

"Optical integrated circuit"

A "monolithic integrated circuit" or a "hybrid integrated circuit", containing one or more parts designed to function as a photosensor or photoemitter or to perform (an) optical or (an) electro-optical function(s).

"Optical switching"

The routing of or switching of signals in optical form without conversion to electrical signals.

"Other fissile material"

"Previously separated" americium-242m, curium-245 and -247, californium-249 and -251, isotopes of plutonium other than plutonium-238 and -239, and any material containing the foregoing.

"Overall current density"

The total number of ampere-turns in the coil (i.e., the sum of the number of turns multiplied by the maximum current carried by each turn) divided by the total cross-section of the coil (comprising the superconducting filaments, the metallic matrix in which the superconducting filaments are embedded, the encapsulating material, any cooling channels, etc.).

"PABX" - see "Private automatic branch exchange".

"Peak power"

Energy per pulse in joules divided by the pulse duration in seconds.

"Personalized smart card"

A smart card containing a microcircuit, in accordance with ISO/IEC 781, which has been programmed by the issuer and cannot be changed by the user.

"Polyclonal antibodies"

A mixture of proteins which bind to the specific antigen and are produced by more than one clone of cells.

"Power management"

Changing the transmitted power of the altimeter signal so that received power at the "aircraft" altitude is always at the minimum necessary to determine the altitude.

"Precursors"

Specialty chemicals used in the manufacture of military explosives.

"Previously separated"

The application of any process intended to increase the concentration of the controlled isotope.

"Principal element"

An element is a "principal element" when its replacement value is more than 35% of the total value of the system of which it is an element. Element value is the price paid for the element by the manufacturer of the system, or by the system integrator. Total value is the normal international selling price to unrelated parties at the point of manufacture or consolidation of shipment.

"Private automatic branch exchange" (PABX)

An automatic telephone exchange, typically incorporating a position for an attendant, designed to provide access to the public network and serving extensions in an institution such as a business, government, public service or similar organisation.

"Production" (2018 only)

Includes design, examination, manufacture, testing and checking.

"Production" (except 2018)

Means all production stages, such as: product engineering, manufacture, integration, assembly (mounting), inspection, testing, quality assurance.

"Programme"

A sequence of instructions to carry out a process in, or convertible into, a form executable by an electronic computer.

"Proof Test"

On-line or off-line production screen testing that dynamically applies a prescribed tensile stress over a 0.5 to 3 m length of fibre at a running rate of 2 to 5 m/s while passing between capstans approximately 150 mm in diameter. The ambient temperature is a nominal 293 K (20 C) and relative humidity 40%.

N.B.: Equivalent national standards for executing the "proof test" may be used.

"Pulse compression"

The coding and processing of a radar signal pulse of long time duration to one of short time duration, while maintaining the benefits of high pulse energy.

"Pulse duration"

Duration of a "laser" pulse measured at Full Width Half Intensity (FWHI) levels.

"Q-switched laser"

A "laser" in which the energy is stored in the population inversion or in the optical resonator and subsequently emitted in a pulse.

"Radar frequency agility"

Any technique which changes, in a pseudo-random sequence, the carrier frequency of a pulsed radar transmitter between pulses or between groups of pulses by an amount equal to or larger than the pulse bandwidth.

"Radar spread spectrum"

Any modulation technique for spreading energy originating from a signal with a relatively narrow frequency band, over a much wider band of frequencies, by using random or pseudo-random coding.

"Range"

Half the maximum distance a submersible vehicle can cover.

"Real time bandwidth"

For "dynamic signal analysers", the widest frequency range which the analyser can output to display or mass storage without causing any discontinuity in the analysis of the input data. For analysers with more than one channel, the channel configuration yielding the widest "real-time bandwidth" shall be used to make the calculation.

"Real time processing"

The processing of data by a computer system providing a required level of service, as a function of available resources, within a guaranteed response time, regardless of the load of the system, when stimulated by an external event.

"Receptors"

Biological macromolecular structures capable of binding ligands, the binding of which affects physiological functions.

"Required"

as applied to "technology", refers to only that portion of "technology" which is peculiarly responsible for achieving or exceeding the embargoed performance levels, characteristics or functions. Such "required" "technology" may be shared by different products.

"Resolution"

The least increment of a measuring device; on digital instruments, the least significant bit.

(Reference: ANSI B-89.1.12)

"Robot"

A manipulation mechanism, which may be of the continuous path or of the point-to-point variety, may use "sensors", and has all the following characteristics:

a. Is multifunctional;

b. Is capable of positioning or orienting material, parts, tools or special devices through variable movements in three dimensional space;

c. Incorporates three or more closed or open loop servo-devices which may include stepping motors; and

d. Has "user-accessible programmability" by means of teach/playback method or by means of an electronic computer which may be a programmable logic controller, i.e., without mechanical intervention.

"Signal analysers"

Apparatus capable of measuring and displaying basic properties of the single-frequency components of multi-frequency signals.

"Signal processing"

The processing of externally derived information-bearing signals by algorithms such as time compression, filtering, extraction, selection, correlation, convolution or transformations between domains (e.g., fast Fourier transform or Walsh transform).

"Source code" (or source language)

A convenient expression of one or more processes which may be turned by a programming system into equipment executable form ("object code" (or object language)).

"Spacecraft"

Active and passive satellites and space probes.

"Space qualified"

Products designed, manufactured and tested to meet the special electrical, mechanical or environmental requirements for use in the launch and deployment of satellites or high altitude flight systems operating at altitudes of 100 km or higher.

"Special fissile material"

Is defined as plutonium-239, uranium-233, uranium enriched in the isotopes 235 or 233, and any material containing the foregoing.

"Specific modulus"

Young's modulus in pascals, equivalent to N/m^2 divided by specific weight in N/m^3, measured at a temperature of (296 ± 2)° K ((23 ± 2)° C) and a relative humidity of (50 ± 5)%.

"Specific tensile strength"

Ultimate tensile strength in pascals, equivalent to N/m^2 divided by specific weight in N/m^3, measured at a temperature of (296 ± 2)° K ((23 ± 2)° C) and a relative humidity of (50 ± 5)%.

"Spectral efficiency"

A figure of merit parametrized to characterize the efficiency of transmission system which uses complex modulation schemes such as QAM (quadrature amplitude modulation), Trellis coding, QPSK (Q-phased shift key), etc. It is defined as follows:

"Digital transfer rate" (bits/second)

$$\text{Spectral efficiency} = \frac{\text{Digital transfer rate (bits per second)}}{\text{6 dB spectrum bandwidth (Hz)}}$$

"Splat Quenching"

A process to "solidify rapidly" a molten metal stream impinging upon a chilled block, forming a flake-like product.

N.B.: "Solidify rapidly": solidification of molten material at cooling rates exceeding 1,000 K/sec.

"Spread spectrum"

The technique whereby energy in a relatively narrow-band communication channel is spread over a much wider energy spectrum.

"Sputtering"

An overlay coating process wherein positively charged ions are accelerated by an electric field towards the surface of a target (coating material). The kinetic energy of the impacting ions is sufficient to cause target surface atoms to be released and deposited on the substrate.

N.B.: Triode, magnetron or radio frequency sputtering to increase adhesion of coating and rate of deposition are ordinary modifications of the process.

"Stabilisers"

Substances used in explosive formulations to improve their shelf-life.

"Stability"

Standard deviation (1 sigma) of the variation of a particular parameter from its calibrated value measured under stable temperature conditions. This can be expressed as a function of time.

"Stored programme controlled"

A control using instructions stored in an electronic storage which a processor can execute in order to direct the performance of predetermined functions.

"Substrate"

A sheet of base material with or without an interconnection pattern and on which or within which "discrete components" or integrated circuits or both can be located.

N.B.: "Discrete component": a separately packaged "circuit element" with its own external connections.

"Substrate blanks"

Monolithic compounds with dimensions suitable for the production of optical elements such as mirrors or optical windows.

"Superalloys"

Nickel-, cobalt- or iron-base alloys having strengths superior to any alloys in the AISI 300 series at temperatures over 922 K (649 C) under severe environmental and operating conditions.

"Superconductive"

Materials, i.e. metals, alloys or compounds, which can lose all electrical resistance, i.e. which can attain infinite electrical conductivity and carry very large electrical current without Joule heating.

N.B.: The "superconductive" state of a material is individually characterised by a "critical temperature", a critical magnetic field, which is a function of temperature, and a critical current density which is, however, a function of both magnetic field and temperature.

"Super High Power Laser" (SHPL)

A "laser" capable of delivering (the total or any portion of) the output energy exceeding 1 kJ within 50 ms or having an average or CW power exceeding 20 kW.

"Superplastic forming"

A deformation process using heat for metals that are normally characterised by low values of elongation (less than 20%) at the breaking point as determined at room temperature by conventional tensile strength testing, in order to achieve elongations during processing which are at least 2 times those values.

"Swept frequency network analysers"

Involve the automatic measurement of equivalent circuit parameters over a range of frequencies, involving swept frequency measurement techniques but not continuous wave point-to-point measurements.

"Switch fabric"

That hardware and associated "software" which provides the physical or virtual connection path for in-transit message traffic being switched.

"Synchronous digital hierarchy" (SDH)

A digital hierarchy providing a means to manage, multiplex and access various forms of digital traffic using a synchronous transmission format on different types of media. The format is based on the Synchronous Transport Module (STM) which is defined by CCITT Recommendation G.703, G.707, G.708, G.709 and others yet to be published. The first level rate of "SDH" is 155.52 Mbit/s.

"Synchronous optical network" (SONET)

A network providing a means to manage, multiplex and access various forms of digital traffic using a synchronous transmission format on fibre optics. The format is the North America version of "SDH" and also uses the Synchronous Transport Module (STM). However, it uses the Synchronous Transport Signal (STS) as the basic transport module with a first level rate of 51.81 Mbit/s. The SONET standards are being integrated into those of "SDH".

"Systems tracks"

Processed, correlated (fusion of radar target data to flight plan position) and updated aircraft flight position report available to the Air Traffic Control centre controllers.

"Systolic array computer"

A computer where the flow and modification of the data is dynamically controllable at the logic gate level by the user.

"Technical assistance"

May take forms, such as instruction, skills, training, working knowledge, consulting services.

N.B.: "Technical assistance" may involve transfer of "technical data".

"Technical data"

May take forms such as blueprints, plans, diagrams, models, formulae, tables, engineering designs and specifications, manuals and instructions written or recorded on other media or devices such as disk, tape, read-only memories.

"Technology"

Specific information necessary for the "development", "production" or "use" of a product. The information takes the form of "technical data" or "technical assistance". Embargoed "technology" is defined in the General Technology Note in the Groups 1, 2 and 3.

"Telecommunication transmission equipment"

a. Categorised as follows, or combinations thereof:

   1. Radio equipment (e.g., transmitters, receivers and transceivers);

   2. Line terminating equipment;

   3. Intermediate amplifier equipment;

   4. Repeater equipment;

   5. Regenerator equipment;

6. Translation encoders (transcoders);

7. Multiplex equipment (statistical multiplex included);

8. Modulators/demodulators (modems);

9. Transmultiplex equipment (see CCITT Rec. G701);

10. "Stored programme controlled" digital crossconnection equipment;

11. "Gateways" and bridges;

12. "Media access units"; and

b. Designed for use in single or multi-channel communication via:

1. Wire (line);

2. Coaxial cable;

3. Optical fibre cable;

4. Electromagnetic radiation.

"Terminal interface equipment"

Equipment at which information enters or leaves the telecommunication system, e.g., telephone, data device, computer, facsimile device.

"Three dimensional Vector Rate"

The number of vectors generated per second which have 10 pixel poly line vectors, clip tested, randomly oriented, with either integer or floating point X-Y-Z coordinate values (whichever produces the maximum rate).

"Tilting spindle"

A tool-holding spindle which alters, during the machining process, the angular position of its centre line with respect to any other axis.

"Time constant"

The time taken from the application of a light stimulus for the current increment to reach a value of 1-1/e times the final value (i.e., 63% of the final value).

"Total digital transfer rate"

The number of bits, including line coding, overhead and so forth per unit time passing between corresponding equipment in a digital transmission system.

"Transfer laser"

A "laser" in which the lasing species is excited through the transfer of energy by collision of a non-lasing atom or molecule with a lasing atom or molecule species.

"Tunable"

The ability of a "laser" to produce a continuous output at all wavelengths over a range of several "laser" transitions. A line selectable "laser" produces discrete wavelengths within one "laser" transition and is not considered "tunable".

"Two dimensional Vector Rate"

The number of vectors generated per second which have 10 pixel poly line vectors, clip tested, randomly oriented, with either integer or floating point X-Y coordinate values (whichever produces the maximum rate).

"Uranium enriched in the isotopes 235 or 233"

Uranium containing the isotopes 235 or 233, or both, in an amount such that the abundance ratio of the sum of these isotopes to the isotope 238 is more than the ratio of the isotope 235 to the isotope 238 occurring in nature (isotopic ratio: 0.72%).

"Use"

Operation, installation (including on-site installation), maintenance (checking), repair, overhaul and refurbishing.

"User-accessible programmability"

The facility allowing a user to insert, modify or replace "programmes" by means other than:

a. A physical change in wiring or interconnections; or

b. The setting of function controls including entry of parameters.

"Vacuum Atomisation"

A process to reduce a molten stream of metal to droplets of a diameter of 500 micrometre or less by the rapid evolution of a dissolved gas upon exposure to a vacuum.

"Variable geometry airfoils"

Use trailing edge flaps or tabs, or leading edge slats or pivoted nose droop, the position of which can be controlled in flight.

ANNEX NO. 2A

Cod importator (Importer code):	Nr. si data inreg. la importator (No. and date of registration at importer):
Importator (Importer):	Nr. si data inreg. la MCT-DCE (No. and date of registration at MTT-DFT):
Adresa (Address):	Partener extern (Foreign partner):
Telefon(Telephone): Telex (Telex): Fax (Fax): Banca (Bank): Cont lei(Lei account): Cont valuta(Currency account):	Tara vinzatoare (Exporting country) : Tara platitoare (Country of payment) Tara de origine (Country of origin)
Destinatar (Addressee):	Conditia de livrare (Delivery terms):
	Conditia de plata si credit (Payment and financing terms)
Termen de valabilitate solicitat (Validity requested):	
Pozitie tarif vamal import(Import custom tarrif heading):	Moneda (valuta) platii (Currency for payment):
Denumirea-comerciala a marfii/operatiunii (Commercial name for the goods/operation):	Cantitate UM tone(Quantity unit) tons________ Cantitate UM supl. (Quantity additional) unit______ Valoare-CIF valuta platii (CIF value in currency of payment):
Alte precizari ale solicitantului (Further details supplied by applicant):	Certificam pe propria raspundere exactitatea datelor inscrise in prezenta cerere si va rugam sa autorizati importul - Numele si prenumele in clar, semnatura autorizata, stampila.(We hereby certify on our own responsibility that all data in this licensing application are accurate and we therefore ask for the import licencing - Last name,first name, authorized signature, seal).

MINISTERUL COMERTULUI SI TURISMULUI (Ministry of Trade and Tourism)
DIRECTIA GENERALA DE POLITICA COMERCIALA (General Directorate for Commercial Policy)

LICENTA DE IMPORT Nr. .... Data: ....
Import licence No. .... Date: ....)
SE AUTORIZEAZA EFECTUAREA IMPORTULUI PINA LA DATA DE: ....
We hereby authorize this import to take place until : ....)
CONFORM PREZENTEI CERERI SI CU URMATOARELE PRECIZARI
(in compliance with the present application, with the following ammendments):

Semnatura autorizata (Authorized signature)

ANNEX NO. 2B

Cod exportator (Exporter code):	Nr. si data inreg. la exportator (No. and date of registration at exporter):
Exportator (Exporter): Adresa (Address):	Nr. si data inreg. la MCT-DCE (No. and date of registration at MTT-DFT): Partener extern (Foreign partner):
Telefon(Telephone): Telex (Telex): Fax (Fax): Banca (Bank): Cont lei(Lei account): Cont valuta(Currency account):	Tara cumparatoare (Importing country): Tara platitoare (Country of payment) Tara de destinatie (Country of destination)
Furnizor (Supplier):	Conditia de livrare (Delivery terms): Conditia de plata si credit (Payment and financing terms):
Termen de valabilitate solicitat (Validity requested):	
Pozitie tarif vamal import(Import custom tarrif heading):	Moneda (valuta) platii (Currency for payment):

Denumirea-comerciala a marfii/operatiunii (Commercial name for the goods/operation):	Cantitate UM tone(Quantity unit) tons________	Cantitate UM supl. (Quantity additional) unit______	Valoare-CIF valuta platii (FOB value in currency of payment):

Alte precizari ale solicitantului (Further details supplied by applicant):	Certificam pe propria raspundere exactitatea datelor inscrise in prezenta cerere si va rugam sa autorizati importul - Numele si prenumele in clar, semnatura autorizata, stampila.(We hereby certify on our own responsibility that all data in this licensing application are accurate and we therefore ask for the import licencing - Last name,first name, authorized signature, seal).

MINISTERUL COMERTULUI SI TURISMULUI (Ministry of Trade and Tourism)
DIRECTIA GENERALA DE POLITICA COMERCIALA (General Directorate for Commercial Policy)

LICENTA DE EXPORT Nr. .... Data: ....
Import licence No. .... Date: ....)
SE AUTORIZEAZA EFECTUAREA EXPORTULUI PINA LA DATA DE: ....
We hereby authorize this export to take place until : ....)
CONFORM PREZENTEI CERERI SI CU URMATOARELE PRECIZARI
(in compliance with the present application,with following ammendments):
ammendments):

Semnatura autorizata (Authorized signature)

ANNEX NO. 3A

IMPORT CERTIFICATE (IC)
(form)

- Supplier/sender/seller/exporter (full name and address)
- End user/addressee/buyer/importer (full name and address)
- Address of destination
- Invoice No................. dated.................
- Full denomination of merchandise
    - Tariff item
    - Item and paragraph number as per list in Annex No.1 and/or 2 to this resolution
    - Detailed description of merchandise
- Quantity
- Value

It is certified that the above mentioned importer:

- has requsted the issue of an IC for the above mentioned merchandise imported from................ (country) and being of origin from................. (country);

- has committed himself not to divert it to another destination before importing it to Romania and/or to transbord or to re-export it without a previous allowance from the Romanian legal authority;

- has committed himself to advise the legal Romanian authority any change occured in the documents or stated facts;

- has committed himself to request an evidence of the import and to transmit it to the supplier/sender/seller/exporter as soon as such an evidence is released to him, especially the DCC, in case of request from him or his Government.

- has committed himself to import it to Romania, in accordance to the legal provisions in force and in the quantities mentioned above.

The data and information contained in this certificate were certified as correct and were mentioned in good faith; any false statement or any failure regarding the subscribed committments are submitting the importer to the penalties mentioned in the legal provisions in force.

Signature
(Body authorized to issue the certificate)

ANNEX No. 3B

IMPORT CERTIFICATE NO........

Validity: 6 months from .... (date)

Request for an Import Certificate
(form)

- Supplier/sender/seller/exporter (full name and address)
- End user/addressee/buyer/importer (full name and address)
- Address of destination
- Invoice No................. dated..................
- Full denomination of merchandise
    - Tariff item
    - Item and paragraph number as per list in Annex No.1 and/or 2 to this resolution
    - Detailed description of merchandise
- Quantity
- Value

Statement

.... (first name and last name), being a legal representative of .... (firm);

- I request the release of an IC for the merchandise described above, imported from...................... (country) and being of origin from ....(country);

- I committ myself not to divert it to another destination before it's import to Romania and/or to transbord or re-export it without a previous allowance from the Romanian legal authority;

- I committ myself to import it to Romania in accordance to the legal provisions in force and in the quantities mentioned above;

- I committ myself to request an evidence of the import and to transmit such evidence to the supplier/sender/seller/exporter as soon as it is released to me, especially the DCC, in case of request from him or from his Government.

I certify the data and information contained in this request being correct and mentioned in good faith; any false statement or failure regarding to the subcribed committments shall expose my firm to the penalties mentioned in the legal provisions in force.

Date...................

Signature...............

ANNEX NO. 4A

Request for an Import Certificate No.......... dated.............

Delivery Control Certificate (DCC)

(form)

- Supplier/sender/seller/exporter (full name and address)
- End user/addressee/buyer/importer (full name and address)
- Address of destination
- Invoice No. .... dated ....
- Full denomination of merchandise
    - Tariff item
    - Item and paragraph number as per Annex No.1 and/or 2 to this resolution
    - Detailed description of merchandise
- Quantity
- Value

It is certified that the above mentioned importer :

- has requested the release of DCC for the merchandise described above, imported from .... (country) and being of origin from................... (country), bought from the supplier mentioned above and being subject of IC No......... dated ....

- has proved that this merchandise was imported in accordance with the legal Romanian provisions and is subject to the Customs Statement No............ dated................. issued by the .... Customs;

- has attached the justifying evidence regarding this import in sustaining this request.

Signature
(Body authorized to issue the DCC)

Delivery Control Certificate No..........., Dated............

Validity: 6 months from.......... (date).

ANNEX NO. 4B

Request for a delivery Control Certificate
(form)

- Supplier/sender/seller/exporter (full name and address)
- End user/addressee/buyer/importer (full name and address)
- Address of destination
- Invoice No .... dated ....
- Full denomination of merchandise
    - Tariff item
    - Item and paragraph number as per list in Annex No.1 and/or 3 to this resolution
    - Detailed description of merchandise
- Quantity
- Value

Statement

.... (first name and last name), being the legal representative of .... (firm):

- I request the release of a Delivery Control Certificate for the merchandise described above, imported from .... (country) and being of origin from ....(country), bought from the supplier/sender/seller/exporter mentioned above and being subject of IC No. .... dated ....

- I certify that this merchandise was imported in accordance with the Romanian legal provisions and is subject to the Customs Statement No. .... dated .... issued by the ....Customs.

- I attach herewith the justifying evidence regarding the import, in sustaining my request.

Detailed identification of the attached evidence

. . . .

. . . .

. . . .

. . . .

First name and last name ....
Date ....
Signature ....

ANNEX No.5

TECHNOLOGIES AND ITEMS SUBJECT TO NON-PROLIFERATION OF NUCLEAR WEAPONS CONTROL

GUIDELINES
for nuclear export control to prevent nuclear weapons proliferation

Whenever requesting the export or import licence for the items listed in this annex, the licence applicant should prove that the competent authorities of the recipient country ensured explicitly that the respective items:

- should be excluded from uses which would result in any nuclear explosive device;

- should be placed under effective physical protection to prevent unauthorized use and handling;

- should be subjected to International Atomic Energy Agency safeguards, in accordance with the GOV/1621 guidelines;

- should be retransferred only upon the supplier's prior consent;

- should not be diverted to another destination;

- should not be diverted from the stated end-use without the prior consent of Romanian competent authorities;

- should be transported with full observance of the specific requirements;

- the applicable radioprotection requirements should be observed.

At the same time, the licence applicant should prove that a financial guarantee can be used to cover the nuclear damage liability at the level established under the Atomic Energy Act.

The issuing of import or export licences for nuclear material, equipments, components thereof or technologies listed in this onus is also conditional upon proving that a specific import or export authorization was issued by the National Commission for Nuclear Activities Control, in accordance with Atomic Energy Act 61/1974.

Section 1

Material, equipments,components thereof and technologies especially designed or prepared for special fissionable material production

BASIC PRINCIPLES

1. The following fundamental principles for safeguards and export controls should apply to nuclear transfers to any non-nuclear weapon State for peaceful purposes.

Prohibition on nuclear explosives

2. Suppliers should authorize transfer of items identified in the trigger list only upon formal governmental assurances from recipients explicitly excluding uses which result in any nuclear explosive device.

Physical protection

3. (a) All nuclear materials and facilities identified by the agreed trigger list should be placed under effective physical protection to prevent unauthorized use and handling. The levels of physical protection to be ensured in relation to the type of materials, equipment and facilities, have been agreed by suppliers, taking account of international recommendations.

   (b) The implementation of measures of physical protection in the recipient country is the responsibility of the Government of that country. However, in order to implement the terms agreed upon amongst suppliers, the levels of physical protection on which these measures have to be based should be the subject of an agreement between supplier and recipient.

   (c) In each case special arrangements should be made for a clear definition of responsibilities for the transport of trigger list items.

Safeguards

4. (a) The export of the trigger list items to any non-nuclear-weapon State may be authorized only when the recipient country has an IAEA full scope safeguards agreement in force applicable to all its existing and future peaceful nuclear activities.

   (b) The import of items identified in the trigger list may be authorized only when covered by IAEA safeguards.

Safeguards triggered by the transfer of certain technology

5. (a) The requirements of paragraphs 2,3 and 4 above should also apply to facilities for reprocessing, enrichment, or heavy-water production, utilizing technology directly transferred by the supplier or derived from transferred facilities, or major critical components thereof.

(b) The transfer of such facilities, or major critical components thereof, or related technology, should require an undertaking (1) that IAEA safeguards apply to any facilities of the same type (i.e. if the design, construction or operating processes are based on the same or similar physical or chemical processes, as defined in the trigger list) constructed during 30 years, after the transfer in the recipient country and (2) that there should at all times be in effect a safeguards agreement permitting the IAEA to apply Agency safeguards with respect to such facilities identified by the recipient, or by the supplier in consultation with the recipient, as using transferred technology.

Special controls on sensitive exports

6. Restraint should be exercised in the transfer of sensitive facilities, technology and weapons-usable materials. The recipients should be encouraged to accept, as an alternative to national plants, any multinational participation involvement in resulting facilities and to promote international (including IAEA) activities concerned with multinational regional fuel cycle centres.

Special controls on export of enrichment facilities, equipment and technology

7. For a transfer of an enrichment facility, or technology therefor, the recipient nation should agree that neither the transferred facility, nor any facility based on such technology, will be designed or operated for the production of greater than 20% enriched uranium without the consent of the supplier nation, of which the IAEA should be advised.

Controls on supplied or derived weapons-usable material

8. In order to advance the objectives of these guidelines and to provide opportunities to further reduce the risks of proliferation, in the agreements on supply of nuclear materials or of facilities which produce weapons-usable material, should be included provisions calling for mutual agreement between the supplier and recipient on arrangements for reprocessing, storage, alternation, use, transfer or retransfer of any weapons-usable material involved.

Controls on retransfer

9. (a) Suppliers should transfer trigger list items, including technology defined under paragraph 5, only upon the recipient's assurance that in the case of:

    (1) retransfer of such items,

    or

    (2) transfer or trigger list items derived from facilities originally transferred from Romania or with the help of equipment or technology originally transferred from Romania;

    the recipient of the retransfer or transfer will have provided the same assurances as those required by the recipient of the original transfer imported from Romania.

   (b) In addition the Romanian authorities consent should be required by the recipient of the transfer for:

    (1) any retransfer of the facilities, major critical components, or technology described in paragraph 5;

    (2) any transfer of facilities or major critical components derived from facilities, major critical components, or technology described in paragraph 5 transferred from Romania;

    (3) any retransfer of heavy water or weapons-usable material.

TRIGGER LIST FOR NUCLEAR MATERIAL, EQUIPMENT AND TECHNOLOGY

PART A. Material and equipment

1. Source and special fissionable material

As defined in Article XX of the Statute of the International Atomic Energy Agency;

1.1 "Source material"

The term "source material" means uranium containing the mixture of isotopes occurring in nature; uranium depleted in the isotope 235; thorium; any of the foregoing in the form of metal, alloy, chemical compound, or concentrate; any other material containing one or more of the foregoing in such concentration as the Board of Governors shall from time to time determine; and such other material as the Board of Governors shall from time to time determine.

1.2. "Special fissionable material"

i) The term "special fissionable material" means plutonium-239; uranium-233; uranium enriched in the isotopes 235 or 233; any material containing one or more of the foregoing; and such other fissionable material as the Board of Governors shall from time to time determine; but the term "special fissionable material" does not include source material.

ii) The term "uranium enriched in the isotopes 235 or 233" means uranium containing the isotopes 235 or 233 or both, in an amount such that the abundance ratio of the sum of these isotopes to the isotope 238 is greater than the ratio of the isotope 235 to the 238 occurring in nature.

However, for the purposes of the Guidelines, items specified in subparagraph (a) below, and exports of source or special fissionable material to a given recipient country, within a period of 12 months, below the limits specified in subparagraph (b) below, shall not be included:

(a) Plutonium with an isotopic concentration of plutonium-238 exceeding 80%.
Special fissionable material when used in gram quantities or less as a sensing component in instruments; and
Source material which the Government is satisfied is to be used only in non-nuclear activities, such as the production of alloys or ceramics;

(b) Special fissionable material 50 effective grams;
Natural uranium 500 kilograms;
Depleted uranium 1000 kilograms; and
Thorium 1000 kilograms.

2. Equipment and Non-nuclear Materials

The designation of items of equipment and non-nuclear materials (hereafter referred to as the "Trigger List") adopted by the Government is as follows (quantities below the levels indicated in the Annex B being regarded as insignificant for practical purpose):

2.1. Reactors and equipment therefor

2.2. Non-nuclear materials for reactors

2.3. Plants for the reprocessing of irradiated fuel elements and equipment especially designed or prepared therefor

2.4. Plants for the fabrication of fuel elements

2.5. Plants for the separation of isotopes of uranium and equipment, other than analytical instruments, especially designed or prepared therefor

2.6. Plants for the production of heavy water, deuterium and deuterium compounds and equipment especially designed or prepared therefor

PART B. Common criteria for technology transfers under paragraph 5 of the Guidelines

(1) "Technology" means technical data in physical form designated by the supplying country as important to the design, construction, operation, or maintenance of enrichment, reprocessing, or heavy water production facilities or major critical components thereof, but excluding data available to the public, for example, in published books and periodicals, or that which has been made available internationally without restrictions upon its further dissemination.

(2) "Major critical components" are:

(a) in the case of an isotope separation plant of the gas centrifuge type: gas centrifuge assemblies, corrosion-resistant to UF_6;

(b) in the case of an isotope separation plant of the gaseous diffusion type: diffusion barrier;

(c) in the case of an isotope separation plant of the jet nozzle type: the nozzle units;

(d) in the case of an isotope separation plant of the vortex type: the vortex units.

(3) For facilities covered by paragraph 5 of the Guidelines for which no major critical component is described in paragraph 2 above, if a supplier nation should transfer in the aggregate a significant fraction of the items essential to the operation of such a facility, together with the knowhow for construction and operation of that facility, that transfer should be deemed to be a transfer of "facilities or major critical components thereof".

(4) The definitions in the preceding paragraphs are solely for the purpose of paragraph 5 of the Guidelines and this Part B, which differ from those applicable to Part A of this Trigger List, which should not be interpreted as limited by such definition.

(5) For the purpose of implementing paragraph 5 of the Guidelines, the following facilities should be deemed to be "of the same type (i.e. if their design, construction or operating processes are based on the same or similar physical or chemical processes)":

Where the technology transferred is such as to make possible the construction in the recipient State of a facility of the following type, or major critical components thereof:	The following will be deemed to be facilities of the same type:
(a) an isotope separation plant of the gaseous diffusion type	any other isotope separation plant using the gaseous diffusion process.
(b) an isotope separation plant of the gas centrifuge type	any other isotope separation plant using the gas centrifuge process.
(c) an isotope separation plant of the jet nozzle type	any other isotope separation plant using the jet nozzle process.
(d) an isotope separation plant of the vortex type	any other isotope separation plant using the vortex process.

(e)	a fuel reprocessing plant using the solvent extraction process.	any other fuel reprocessing plant using the solvent extraction process.
(f)	a heavy water plant using the exchange process	any other heavy water plant using the exchange process.
(g)	a heavy water plant using the electrolytic process	any other heavy water plant using the electrolytic process.
(h)	a heavy water plant using the hydrogen distillation process	any other heavy water plant using the hydrogen distillation process.

Note: In the case of reprocessing, enrichment, and heavy water facilities whose design, construction, or operation processes are based on physical or chemical processes other than those enumerated above, a similar approach would be applied to define facilities "of the same type", and a need to define major critical components of such facilities might arise.

(6) The reference in paragraph 5 b) of the Guidelines to "any facilities of the same type constructed during an agreed period in the recipient's country" is understood to refer to such facilities (or major critical components thereof), the first operation of which commences within a period of at least 20 years from the date of the first operation of (1) a facility which has been transferred or incorporates transferred major critical components or of (2) a facility of the same type built after the transfer of technology. It is understood that during that period there would be a conclusive presumption that any facility of the same type utilized transferred technology. But the agreed period is not intended to limit the duration of the safeguards imposed or the duration of the right to identify facilities as being constructed or operated on the basis of or by the use of transferred technology in accordance with paragraph 5 (b) (2) of the Guidelines.

CLARIFICATION OF ITEMS ON THE TRIGGER LIST

1. Reactors and equipment therefor

1.1 Complete nuclear reactors

Nuclear reactors capable of operation so as to maintain a controlled self-sustaining fission chain reaction, excluding zero energy reactors, the latter being defined as reactors with a designed maximum rate of production of plutonium not exceeding 100 grams per year.

EXPLANATORY NOTE

A "nuclear reactor" basically includes the items within or attached directly to the reactor vessel, the equipment which controls the level of power in the core, and the components which normally contain or come in direct contact with or control the primary coolant of the reactor core.

It is not intended to exclude reactors which could reasonably be capable of modification to produce significantly more than 100 grams of plutonium per year. Reactors designed for sustained operation at significant power levels, regardless of their capacity for plutonium production, are not considered as "zero energy reactors".

EXPORTS

The export of the whole set of major items within this boundary will take place only in accordance with the procedures of the Guidelines. Those individual items within this functionally defined boundary which will be exported only in accordance with the procedures of the Guidelines are listed in paragraphs 1.2 to 1.7. The Government reserves the right to apply the procedures of the Guidelines to other items within the functionally defined boundary.

1.2 Reactor pressure vessels

Metal vessels, as complete units or major shop-fabricated parts therefor, which are especially designed or prepared to contain the core of a nuclear reactor as defined in paragraph 1.1 above and are capable of withstanding the operating pressure of the primary coolant.

EXPLANATORY NOTE

A top plate for a reactor pressure vessel is covered by item 1.2 as a major shop-fabricated part of a pressure vessel.

Reactor internals (eg support columns and plates for the core and other vessel internals, control rod guide tubes, thermal shields, baffles, core grid plates, diffuser plates, etc.) are normally supplied by the reactor supplier. In some cases, certain internal support components are included in the fabrication of the pressure vessel. These items are sufficiently critical to the safety and reliability of the operation of the reactor (and, therefore, to the guarantees and liability of the reactor supplier), so that their supply, outside the basic supply arrangement for the reactor itself, would not be common practice. Therefore, although the separate supply of these unique, especially designed and prepared, critical, large and expensive items would not necessarily be considered as falling outside the area of concern, such a mode of supply is considered unlikely.

1.3 Reactor fuel charging and discharging machines

Manipulative equipment especially designed or prepared for inserting or removing fuel in a nuclear reactor as defined in paragraph 1.1 above capable of on-load operation or employing technically sophisticated positioning or alignment features to allow complex off-load fuelling operations such as those in which direct viewing of or access to the fuel is not normally available.

1.4 Reactor control rods

Rods especially designed or prepared for the control of the reaction rate in a nuclear reactor as defined in paragraph 1.1 above.

EXPLANATORY NOTE

This item includes, in addition to the neutron absorbing part, the support or suspension structures therefor if supplied separately.

1.5 Reactor pressure tubes

Tubes which are especially designed or prepared to contain fuel elements and the primary coolant in a reactor as defined in paragraph 1.1 above at an operating pressure in excess of 5.1 MPa (740 psi).

1.6 Zirconium tubes

Zirconium metal and alloys in the form of tubes or assemblies of tubes, and in quantities exceeding 500 kg in any period of 12 months, especially designed or prepared for use in a reactor as defined in paragraph 1.1 above, and in which the relation of hafnium to zirconium is less than 1:500 parts by weight.

1.7 Primary coolant pumps

Pumps especially designed or prepared for circulating liquid metal as primary coolant for nuclear reactors as defined in paragraph 1.1 above.

2. Non-nuclear materials for reactors

2.1 Deuterium and heavy water

Deuterium, heavy water (deuterium oxide) and any other deuterium compound in which the ratio of deuterium to hydrogen atoms exceeds 1:5000 for use in a nuclear reactor as defined in paragraph 1.1 above in quantities exceeding 200 kg of deuterium atoms for any one recipient country in any period of 12 months.

2.2 Nuclear grade graphite

Graphite having a purity level better than 5 parts per million boron equivalent and with a density greater than 1.50 g/cm^3 in quantities exceeding 3×10^4 kg (30 metric tons) for any one recipient country in any period of 12 months.

3. Plants for the reprocessing of irradiated fuel elements, and equipment especially designed or prepared therefor

INTRODUCTORY NOTE

Reprocessing irradiated nuclear fuel separates plutonium and uranium from intensely radioactive fission products and other transuranic elements. Different technical processes can accomplish this separation. However, over the years Purex has become the most commonly used and accepted process. Purex involves the dissolution of irradiated nuclear fuel in nitric acid, followed by separation of the uranium, plutonium, and fission products by solvent extraction using a mixture of tributyl phosphate in an organic diluent.

Purex facilities have process functions similar to each other, including: irradiated fuel element chopping, fuel dissolution, solvent extraction, and process liquor storage. There may also be equipment for thermal denitration of uranium nitrate, conversion of plutonium nitrate to oxide or metal, and treatment of fission product waste liquor to a form suitable for long term storage or disposal. However, the specific type and configuration of the equipment performing these functions may differ between Purex facilities for several reasons, including the type and quantity of irradiated nuclear fuel to be reprocessed and the intended disposition of the recovered materials, and the safety and maintenance philosophy incorporated into the design of the facility.

A "plant for the reprocessing of irradiated fuel elements", includes the equipment and components which normally come in direct contact with and directly control the irradiated fuel and major nuclear material and fission product processing streams.

These processes, including the complete systems for plutonium conversion and plutonium metal production, may be identified by the measures taken to avoid critically (eg by geometry), radiation exposure (eg by shielding), and toxicity hazards (eg by containment).

EXPORTS

The export of the whole set of major items within this boundary will take place only in accordance with the procedures of the Guidelines.

The Government reserves to itself the right to apply the procedures of the Guidelines to other items within the functionally defined boundary as listed below.

Items of equipment that are considered to fall within the meaning of the phrase "and equipment especially designed or prepared" for the reprocessing of irradiated fuel elements include:

3.1 Irradiated fuel element chopping machines

INTRODUCTORY NOTE

This equipment breaches the cladding of the fuel to expose the irradiated nuclear material to dissolution. Especially designed metal cutting shears are the most commonly employed, although advanced equipment, such as lasers, may be used.

Remotely operated equipment especially designed or prepared for use in a reprocessing plant as identified above and intended to cut, chop or shear irradiated nuclear fuel assemblies, bundles or rods.

3.2 Dissolvers

INTRODUCTORY NOTE

Dissolvers normally receive the chopped-up spent fuel. In these critically safe vessels, the irradiated nuclear material is dissolved in nitric acid and the remaining hulls removed from the process stream.

Critically safe tanks (eg small diameter, annular or slab tanks) especially designed or prepared for use in a reprocessing plant as identified above, intended for dissolution of irradiated nuclear fuel and which are capable of withstanding hot, highly corrosive liquid, and which can be remotely loaded and maintained.

3.3 Solvent extractors and solvent extraction equipment

INTRODUCTORY NOTE

Solvent extractors both receive the solution of irradiated fuel from the dissolvers and the organic solution which separates the uranium, plutonium, and fission products. Solvent extraction equipment is normally designed to meet strict operating parameters, such as long operating lifetimes with no maintenance requirements or adaptability to easy replacement, simplicity of operation and control, and flexibility for variations in process conditions.

Especially designed or prepared solvent extractors such as packed or pulse columns, mixer settlers or centrifugal contractors for use in a plant for the reprocessing of irradiated fuel. Solvent extractors must be resistant to the corrosive effect of nitric acid. Solvent extractors are normally fabricated to extremely high standards(including special welding and inspection and quality assurance and quality control techniques) out of low carbon stainless steels, titanium, zirconium, or other high quality materials.

3.4 Chemical holding or storage vessels

INTRODUCTORY NOTE

Three main process liquor streams result from the solvent extraction step. Holding or storage vessels are used in the further processing of all three streams, as follows:

(a) The pure uranium nitrate solution is concentrated by evaporation and passed to a denitration process where it is converted to uranium oxide. This oxide is re-used in the nuclear fuel cycle.

(b) The intensely radioactive fission products solution is normally concentrated by evaporation and stored as a liquor concentrate. This concentrate may be subsequently evaporated and converted to a form suitable for storage or disposal.

(c) The pure plutonium nitrate solution is concentrated and stored pending its transfer to further process steps. In particular, holding or storage vessels for plutonium solutions are designed to avoid criticality problems resulting from changes in concentration and form of this stream.

Especially designed or prepared holding or storage vessels for use in a plant for the reprocessing or irradiated fuel. The holding or storage vessels must be resistant to the corrosive effect of nitric acid. The holding or storage vessels are normally fabricated of materials such as low carbon stainless steels, titanium or zirconium, or other high quality materials. Holding or storage vessels may be designed for remote operation and maintenance and may have the following features for control or nuclear criticality:

(1) walls or internal structures with a boron equivalent of at least two per cent, or
(2) a maximum diameter of 175 mm (7 in) for cylindrical vessels, or
(3) a maximum width of 75 mm (3 in) for either a slab or annular vessel.

3.5 Plutonium nitrate to oxide conversion system

INTRODUCTORY NOTE

In most reprocessing facilities, this final process involves the conversion of the plutonium nitrate solution to plutonium dioxide. The main functions involved in this process are:process feed storage or adjustment, precipitation and solid/liquor separation, calcination, product handling, ventilation, waste management, and process control.

Complete systems especially designed or prepared for the conversion of plutonium nitrate to plutonium oxide, in particular adapted so as to avoid criticality and radiation effects and to minimize toxicity hazards.

3.6 Plutonium oxide to metal production system

INTRODUCTORY NOTE

This process, which could be related to a reprocessing facility, involves the fluorination of plutonium dioxide, normally with highly corrosive hydrogen fluoride, to produce plutonium fluoride which is subsequently reduced using high purity calcium metal to produce metallic plutonium and calcium fluoride slag. The main functions involved in this process are: fluorination (eg involving equipment fabricated or lined with a precious metal), metal reduction (eg employing ceramic crucibles), slag recovery, product handling, ventilation, waste management and process control.

Complete systems especially designed or prepared for the production of plutonium metal, in particular adapted so as to avoid criticality and radiation effects and to minimize toxicity hazards.

4. Plants for the fabrication of fuel elements

A "plant for the fabrication of fuel elements" includes the equipment:

(a) Which normally comes in direct contact with, or directly processes, or controls, the production flow of nuclear materials, or

(b) Which seals the nuclear material within the cladding.

EXPORTS

The export of the whole set of items for the foregoing operations will take place only in accordance with the procedures of the Guidelines. The Government will also give consideration to application of the procedures of the Guidelines to individual items intended for any of the foregoing operations, as well as for other fuel fabrication operations such as checking the integrity of the cladding or the seal, and the finishing treatment or the sealed fuel.

5. Plants for the separation of isotopes of uranium and equipment, other than analytical instruments, especially designed or prepared therefor

Items of equipment that are considered to fall within the meaning of the phrase "equipment, other than analytical instruments, especially designed or prepared" for the separation of isotopes of uranium include:

5.1 Gas centrifuges and assemblies and components especially designed or prepared for use in gas centrifuges

INTRODUCTORY NOTE

The gas centrifuge normally consists of a thin-walled cylinder(s) of between 75 mm (3 in) and 400 mm (16 in) diameter contained in a vacuum environment and spun at high peripheral speed of the order of 300 m/s or more with its central axis vertical. In order to achieve high speed the materials of construction for the rotating components have to be of a high strength to density ratio and the rotor assembly, and hence its individual components, have to be manufactured to very close tolerances in order to minimize the unbalance. In contrast to other centrifuges, the gas centrifuge for uranium enrichment is characterized by having within the rotor chamber a rotating disc-shaped baffle(s) and a stationary tube arrangement for feeding and extracting the UF_6 gas and featuring at least 3 separate channels, of which 2 are connected to scoops extending from the rotor axis towards the periphery of the rotor chamber. Also contained within the vacuum environment are a number of critical items which do not rotate and which although they are especially designed are not difficult to fabricate nor are they fabricated out of unique materials. A centrifuge facility however requires a large number of these components, so that quantities can provide an important indication of end use.

5.1.1 Rotating components

(a) Complete rotor assemblies:
Thin-walled cylinders, or a number of interconnected thin-walled cylinders, manufactured from one of the high strength to density ratio materials described in the EXPLANATORY NOTE to this Section; if interconnected, the cylinders are joined together by flexible bellows or rings as described in section 5.1.1 (c) following. The rotor is fitted with an internal baffle(s) and end caps, as described in section 5.1.1 (d) and (e) following, if in final form. However the complete assembly may be delivered only partly assembled.

(b) Rotor tubes:
Especially designed or prepared thin-walled cylinders with thickness of 12 mm (0.5 in) or less, a diameter between 75 mm (3 in) and 400 mm (16 in), and manufactured from one of the high strength to density ratio materials described in the EXPLANATORY NOTE to this Section.

(c) Rings or Bellows:
Components especially designed or prepared to give localized support to the rotor tube or to join together a number of rotor tubes. The bellows is a short cylinder of wall thickness 3 mm (0.12 in) or less, a diameter of between 75 mm (3 in) and 400 mm (16 in), having a convolute, and manufactured from one of the high strength to density ratio materials described in the EXPLANATORY NOTE to this Section.

(d) Baffles:
Disc-shaped components of between 75 mm (3 in) and 400 mm (16 in) diameter especially designed or prepared to be mounted inside the centrifuge rotor tube, in order to isolate the take-off chamber from the main separation chamber and, in some cases, to assist the UF_6 gas circulation within the main separation chamber of the rotor tube, and manufactured from one of the high strength to density ratio materials described in the EXPLANATORY NOTE to this Section.

(e) Top caps/Bottom caps:
Disc-shaped components of between 75 mm (3 in) and 400 mm (16 in) diameter especially designed or prepared to fit to the ends of the rotor tube, and so contain the UF_6 within the rotor tube, and in some cases to support, retain or contain as an integrated part an element of the upper bearing (top cap) or to carry the rotating elements of the motor and lower bearing (bottom cap), and manufactured from one of the high strength to density ratio materials described in the EXPLANATORY NOTE to this Section.

EXPLANATORY NOTE

The materials use for centrifuge rotating components are:
(a) Maraging steel capable of an ultimate tensile strength of 2.05×10^9 N/m^2 (300,000 psi) or more;
(b) Aluminium alloys capable of an ultimate tensile strength of 0.46×10^9 N/m^2 (67,000 psi) or more;
(c) Filamentary materials suitable for use in composite structures and having specific modulus of 12.3×10^6m or greater and a specific ultimate tensile strength of 0.3×10^6 m or greater ('Specific Modulus' is the Young's Modulus in N/m^2 divided by the specific weight in N/m^3; 'Specific Ultimate Tensile Strength' is the ultimate tensile strength in N/m^2 divided by the specific weight in N/m^3).

5.1.2 Static components

(a) Magnetic suspension bearings:
Especially designed or prepared bearing assemblies consisting of an annular magnet suspended within a housing containing a damping medium. The housing will be manufactured from a UF_6-resistant material (see EXPLANATORY NOTE to Section 5.2). The magnet couples with a pole piece or a second magnet fitted to the top cap described in Section 5.1.1.(e). The magnet may be ring-shaped with a relation between outer and inner diameter smaller or equal to 1.6:1. The magnet may be in a form having an initial permeability of 0.15 H/m (120,000 in CGS units) or more, or a remanence of 98.5% or more, or an energy product of greater than 80 kJ/m^3 (10^7 gauss-oersteds). In addition to the usual material properties, it is a prerequisite that the deviation of the magnetic axes from the geometrical axes is limited to very small tolerances (lower than 0.1 mm or 0.004 in) or that homogeneity of the material of the magnet is specially called for.

(b) Bearings/Dampers:
Especially designed or prepared bearings comprising a pivot/cup assembly mounted on a damper. The pivot is normally a hardened steel shaft polished into a hemisphere at one end with a means of attachment to the bottom cap described in

section 5.1.1 (e) at the other. The shaft may however have a hydrodynamic bearing attached. The cup is pellet-shaped with a hemispherical indentation in one surface. These components are often supplied separately to the damper.

(c) Molecular pumps:
Especially designed or prepared cylinders having internally machined or extruded helical grooves and internally machined bores. Typical dimensions are as follows: 75 mm (3 in) to 400 mm (16 in) internal diameter, 10 mm (0.4 in) or more wall thickness, 1 to 1 length to diameter ratio. The grooves are typically rectangular in cross-section and 2 mm (0.08 in) or more in depth.

(d) Motor stators:
Especially designed or prepared ring-shaped stators for high speed multiphase AC hysteresis (or reluctance) motors for synchronous operation within a vacuum in the frequency range of 600 - 2000 Hz and a power range of 50 - 1000 VA. The stators consist of multi-phase windings on a laminated low loss iron core comprised of thin layers typically 2.0 mm (0.08 in) thick or less.

5.2 Especially designed or prepared auxiliary systems, equipment and components for gas centrifuge enrichment plants

INTRODUCTORY NOTE

The auxiliary systems, equipment and components for a gas centrifuge enrichment plant are the systems of plant needed to feed UF_6 to the centrifuges, to link the individual centrifuges to each other to form cascades (or stages) to allow for progressively higher enrichment and to extract the 'product' and 'tails' UF_6 from the centrifuges, together with the equipment required to drive the centrifuges or to control the plant.

Normally UF_6 is evaporated from the solid using heated autoclaves and is distributed in gaseous form to the centrifuges by way of cascade header pipework. The 'product' and 'tails' UF_6 gaseous streams flowing from the centrifuges are also passed by way of cascade header pipework to cold traps (operating at about 203 K (-70° C)) where they are condensed prior to onward transfer into suitable containers for transportation or storage. Because an enrichment plant consists of many thousands of centrifuges arranged in cascades there are many kilometres of cascade header pipework, incorporating thousands of welds with a substantial amount of repetition of layout. The equipment, components and piping systems are fabricated to very high vacuum and cleanliness standards.

5.2.1 Feed systems/product and tails withdrawal systems

Especially designed or prepared process systems including:
Feed autoclaves (or stations), used for passing UF_6 to the centrifuge cascades at up to 100 kPa (15 psi) and at a rate of 1 kg/h or more;
Desublimers (or cold traps) used to remove UF_6 from the cascades at up to 3 kPa (0.5 psi) pressure. The desublimers are capable of being chilled to 203 K (-70° C) and heated to 343 K (70° C);
"Product" and "Tails" stations used for trapping UF_6 into containers.
This plant, equipment and pipework is wholly made of or lined with UF_6 - resistant materials (see EXPLANATORY NOTE to this section) and is fabricated to very high vacuum and cleanliness standards.

5.2.2 Machine header piping systems

Especially designed or prepared piping systems and header systems for handling UF_6 within the centrifuge cascades. The piping network is normally of the 'triple' header system with each centrifuge connected to each of the headers. There is thus a substantial amount of repetition in its form. It is wholly made of UF_6 - resistant materials (see EXPLANATORY NOTE to this section) and is fabricated to very high vacuum and cleanliness standards.

5.2.3 UF_6 mass spectrometers/ion sources

Especially designed or prepared magnetic or quadrupole mass spectrometers capable of taking 'on-line' samples of feed, product or tails, from UF_6 gas streams and having all the following characteristics:

1. Unit resolution for atomic mass unit greater than 320;
2. Ion sources constructed of or lined with nichrome or monel or nickel plated;
3. Electron bombardment ionization sources;
4. Having a collector system suitable for isotopic analysis.

5.2.4. Frequency changers

Frequency changers (also known as converters or invertors) especially designed or prepared to supply motor stators as defined under 5.1.2.(d), or parts, components and sub-assemblies of such frequency changers having all the following characteristics:

1. A multiphase output of 600 to 2000 Hz;
2. High stability (with frequency control better than 0.1%);
3. Low harmonic distortion (less than 2%); and
4. An efficiency of greater than 80%.

EXPLANATORY NOTE

The items listed above either come into direct contact with the UF_6 process gas or directly control the centrifuges and the passage of the gas from centrifuge to centrifuge and cascade to cascade.

Materials resistant to corrosion by UF_6 include stainless steel, aluminium, aluminium alloys, nickel or alloys containing 60% or more nickel.

5.3. Especially designed or prepared assemblies and components for use in gaseous diffusion enrichment

INTRODUCTORY NOTE

In the gaseous diffusion method of uranium isotope separation, the main technological assembly is a special porous gaseous diffusion barrier, heat exchanger for cooling the gas (which is heated by the process of compression), seal valves and control valves, and pipelines. Inasmuch as gaseous diffusion technology uses uranium hexaflouride (UF_6), all equipment, pipeline and instrumentation surfaces (that come in contact with the gas) must be made of materials that remain stable in contact with UF_6. A gaseous diffusion facility requires a number of these assemblies, so that quantities can provide an important indication of end use.

5.3.1. Gaseous diffusion barriers

(a) Especially designed or prepared thin, porous filters, with a pore size of 100 - 1,000 Å (angstroms), a thickness of 5 mm (0.2 in) or less, and for tubular forms, a diameter of 25 mm (1 in) or less, made of metallic, polymer or ceramic materials resistant to corrosion by UF_6, and

(b) especially prepared compounds or powders for the manufacture of such filters. Such compounds and powders include nickel or alloys containing 60 per cent or more nickel, aluminium oxide, or UF_6 - resistant fully fluorinated hydrocarbon polymers having purity of 99.9 per cent or more, a particle size less than 10 microns, and a high degree of particle size uniformity, which are especially prepared for the manufacture of gaseous diffusion barriers.

5.3.2. Diffuser housings

Especially designed or prepared hermetically sealed cylindrical vessels greater than 300 mm (12 in) in diameter and greater than 900 mm (35 in) in length, or rectangular vessels of comparable dimensions, which have an inlet connection and two outlet connections all of which are greater than 50 mm (2 in) in diameter, for containing the gaseous diffusion barrier, made of or lined with UF_6 - resistant materials and designed for horizontal or vertical installation.

5.3.3. Compressors and gas blowers

Especially designed or prepared axial, centrifugal, or positive displacement compressors, or gas blowers with a suction volume capacity of 1 m^3/min or more of UF_6, and with a discharge pressure of up to several hundred kPa (100 psi), designed for long-term operation in the UF_6 environment with or without an electrical motor of appropriate power, as well as separate assemblies of such compressors and gas blowers. These compressors and gas blowers have a pressure ratio between 2:1 and 6:1 and are made of, or lined with, materials resistant to UF_6.

5.3.4. Rotary shaft seals

Especially designed or prepared vacuum seals, with seal feed and seal exhaust connections, for sealing the shaft connecting the compressor or the gas blower rotor with the driver motor so as to ensure a reliable seal against in-leaking of air into the inner chamber of the compressor or gas blower which is filled with UF_6. Such seals are normally designed for a buffer gas in-leakage rate of less than 1000 cm^3/min (60 in^3/min).

5.3.5. Heat exchangers for cooling UF_6

Especially designed or prepared heat exchangers made of or lined with UF_6 - resistant materials (except stainless steel) or with copper or any combination of those metals, and intended for a leakage pressure change rate of less than 10 Pa (0.0015 psi) per hour under a pressure difference of 100 kPa (15 psi).

5.4. Especially designed or prepared auxiliary systems, equipment and components for use in gaseous diffusion enrichment

INTRODUCTORY NOTE

The auxiliary systems, equipment and components for gaseous diffusion enrichment plants are the systems of plant needed to feed UF_6 to the gaseous diffusion assembly, to link the individual assemblies to each other to form cascades (or stages) to allow for progressively higher enrichments and to extract the 'product' and 'tails' UF_6 from the diffusion cascades. Because of the high inertial properties of diffusion cascades, any interruption in their operation, and especially their shut-down, leads to serious consequences. Therefore, a strict and constant maintenance of vacuum in all technological systems, automatic protection from accidents, and precise automated regulation of the gas flow is of importance in a gaseous diffusion plant. All this leads to a need to equip the plant with a large number of special measuring, regulating and controlling systems. Normally UF_6 is evaporated from cylinders placed within autoclaves and is distributed in gaseous form to the entry point by way of cascade header pipework. The 'product' and 'tails' UF_6 gaseous streams flowing from exit points are passed by way of cascade header pipework to either cold traps or to compression stations where the UF_6 gas is liquefied prior to onward transfer into suitable containers for transportation or storage. Because a gaseous diffusion enrichment plant consists of a large number of gaseous diffusion assemblies arranged in cascades, there are many kilometres of cascade header pipework, incorporating thousands of welds with substantial amounts of repetition of layout. The equipment, components and piping systems are fabricated to very high vacuum and cleanliness standards.

5.4.1. Feed systems/product and tails withdrawal systems

Especially designed or prepared process systems, capable of operating at pressures of 300 kPa (45 psi) or less, including:

Feed autoclaves (or systems), used for passing UF_6 to the gaseous diffusion cascades;

Desublimers (or cold traps) used to remove UF_6 from diffusion cascades;

Liquefaction stations where UF_6 gas from the cascade is compressed and cooled to form liquid UF_6;

"Product" or "tails" stations used for transferring UF_6 into containers.

5.4.2. Header piping systems

Especially designed or prepared piping systems and header systems for handling UF_6 within the gaseous diffusion cascades. This piping network is normally of the 'double' header system with each cell connected to each of the headers.

5.4.3. Vacuum systems

(a) Especially designed or prepared large vacuum manifolds, vacuum headers and vacuum pumps having a suction capacity of 5 m^3/min (175 ft^3/min) or more.

(b) Vacuum pumps especially designed for service in UF_6-bearing atmosphere made of, or lined with, aluminium, nickel, or alloys bearing more than 60% nickel. These pumps may be either rotary or positive, may have displacement and fluorocarbon seals, and may have special working fluids present.

5.4.4. Special shut-off and control valves

Especially designed or prepared manual or automated shut-off and control bellows valves made of UF_6 - resistant materials with a diameter of 40 to 1500 mm (1.5 to 59 in) for installation in main and auxiliary systems of gaseous diffusion enrichment plants.

5.4.5. UF_6 mass spectrometers/ion sources

Especially designed or prepared magnetic or quadrupole mass spectrometers capable of taking "on-line" samples of feed, product or tails, from UF_6 gas streams and having all the following characteristics:

1. Unit resolution for atomic mass unit greater than 320;
2. Ion sources constructed of or lined with nichrome or monel or nickel plated;
3. Electron bombardment ionization sources;
4. Collector system suitable for isotopic analysis.

EXPLANATORY NOTE

The items listed above either come into direct contact with the UF_6 process gas or directly control the flow within the cascade. All surfaces which come into contact with the process gas are wholly made of, or lined with, UF_6 - resistant materials. For the purpose of the sections relating to gaseous diffusion items the materials resistant to corrosion by UF_6 include stainless steel, aluminium, aluminium alloys, aluminium oxide, nickel or alloys containing 60% or more nickel and UF_6 - resistant fully fluorinated hydrocarbon polymers.

5.5. Jet nozzle separation units

5.6. Vortex separation units

6. Plants for the production of heavy water, deuterium compounds and equipment especially designed or prepared therefor

INTRODUCTORY NOTE

Heavy water can be produced by a variety of processes. However, the two processes that have proven to be commercially viable are the water-hydrogen sulphide exchange process (GS process) and the ammonia-hydrogen exchange process.

The GS process is based upon the exchange of hydrogen and deuterium between water and hydrogen sulphide within a series of towers which are operated with the top section cold and the bottom section hot. Water flows down the towers while the hydrogen sulphide gas circulates from the bottom to the top of the towers. A series of perforated trays are used to promote mixing between the gas and the water. Deuterium migrates to the water at low temperatures and to the hydrogen sulphide at high temperatures. Gas or water, enriched in deuterium, is removed from the first stage towers at the junction of the hot and cold sections ,and the process is repeated in subsequent stage towers. The product of the last stage, water enriched up to 30% in deuterium, is sent to a distillation unit to produce reactor grade heavy water; i.e. 99.75% deuterium oxide.

The ammonia-hydrogen exchange process can extract deuterium from synthesis gas through contact with liquid ammonia in the presence of a catalyst. The synthesis gas is fed into exchange towers and to an ammonia converter. Inside the towers the gas flows from the bottom to the top while the liquid ammonia flows from the top to the bottom. The deuterium is stripped from the hydrogen in the synthesis gas and concentrated in the ammonia. The ammonia then flows into an ammonia cracker at the bottom of the tower while the gas flows into an ammonia converter at the top. Further enrichment takes place in subsequent stages and reactor grade heavy water is produced through final distillation. The synthesis gas feed can be provided by an ammonia plant that, in turn, can be constructed in association with a heavy water ammonia-hydrogen exchange plant. The ammonia-hydrogen exchange process can also use ordinary water as a feed source of deuterium.

Many of the key equipment items for heavy water production plants using GS or the ammonia-hydrogen exchange processes are common to several segments of the chemical and petroleum industries. This is a particularly so for small plants using the GS process. However, few of the items are available 'off-the-shell'. The GS and ammonia-hydrogen processes require the handling of large quantities of flammable, corrosive and toxic fluids at elevated pressures. Accordingly, in establishing the design and operating standards for plants and equipment using these processes, careful attention to the materials selection and specifications is required to ensure long service life with high safety and reliability factors. The choice of scale is primarily a function of economics and need. Thus, most of the equipment items would be prepared according to the requirements of the customer.

Finally, it should be noted that, in both GS and the ammonia-hydrogen exchange processes, items of equipment which individually are not especially designed or prepared for heavy water production can be assembled into systems which are especially designed or prepared for producing heavy water. The catalyst production system used in the ammonia-hydrogen exchange process and water distillation systems used for the final concentration of heavy water to reactor-grade in either process are examples of such systems.

The items of equipment which are especially designed or prepared for the production of heavy water utilizing either the water-hydrogen sulphide exchange process or the ammonia-hydrogen exchange process include the following:

6.1. Water - Hydrogen Sulphide Exchange Towers

Exchange towers fabricated from fine carbon steel (such as ASTM A516) with diameters of 6 m (20 ft) to 9 m (30 ft), capable of operating at pressures greater than or equal to 2 MPa (300 psi) and with a corrosion allowance of 6 mm or greater, especially designed or prepared for heavy water production utilizing the water-hydrogen sulphide exchange process.

6.2. Blowers and Compressors

Single stage, low head (i.e., 0.2 MPa or 30 psi) centrifugal blowers or compressors for hydrogen sulphide gas circulation (i.e., gas containing more than 70% H_2S) especially designed or prepared for heavy water production utilizing the water-hydrogen sulphide exchange process. These blowers or compressors have a throughput capacity greater than or equal to 56 m^3/second (120,000 SCFM) while operating at pressures greater than or equal to 1.8 MPa (260 psi) suction and have seals designed for wet H_2S service.

6.3. Ammonia-Hydrogen Exchange Towers

Ammonia-hydrogen exchange towers greater than or equal to 35 m (114.3 ft) in height with diameters of 1.5 m (4.9 ft) to 2.5 m (8.2 ft) capable of operating at pressures greater than 15 MPa (2225 psi) especially designed or prepared for heavy water production utilizing the ammonia-hydrogen exchange process. These towers also have at least one flanged, axial opening of the same diameter as the cylindrical part through which the tower internals can be inserted or withdrawn.

6.4. Tower Internals and Stage Pumps

Tower internals and stage pumps especially designed or prepared for towers for heavy water production utilizing the ammonia-hydrogen exchange process. Tower internals include especially designed stage contactors which promote intimate gas/liquid contact. Stage pumps include especially designed submersible pumps for circulation of liquid ammonia within a contacting stage internal to the stage towers.

6.5. Ammonia Crackers

Ammonia crackers with operating pressures greater than or equal to 3 Mpa (450 psi) especially designed or prepared for heavy water production utilizing the ammonia-hydrogen exchange process.

6.6. Infrared Absorption Analyzers

Infrared absorption analyzers capable of "on-line" hydrogen/deuterium ratio analysis where deuterium concentrations are equal to or greater than 90%.

6.7. Catalytic Burners

Catalytic burners for the conversion of enriched deuterium gas into heavy water especially designed or prepared for heavy water production utilizing the ammonia-hydrogen exchange process.

CRITERIA FOR LEVELS OF PHYSICAL PROTECTION

1. The purpose of physical protection of nuclear materials is to prevent unauthorized use and handling of these materials. Paragraph 3(a) of the Guidelines document calls for agreement among suppliers on the levels of protection to be ensured in relation to the type of materials, and equipment and facilities containing these materials, taking account of international recommendations.

2. Paragraph 3(b) of the Guidelines document states that implementation of measures of physical protection in the recipient country is the responsibility of the Government of that country. However, the levels of physical protection on which these measures have to be based should be the subject of an agreement between supplier and recipient. In this context these requirements should apply to all States.

3. The document INFCIRC/225 of the International Atomic Energy Agency entitled 'The Physical Protection of Nuclear Material' and similar documents which from time to time are prepared by international groups of experts and updated as appropriate to account for changes in the state of the art and state of knowledge with regard to physical protection of nuclear material are a useful basis for guiding recipient States in designing a system of physical protection measures and procedures.

4. The categorization of nuclear material presented in the attached table or as it may be updated from time to time by mutual agreement of suppliers shall serve as the agreed basis for designating specific levels of physical protection in relation to the type of materials, and equipment and facilities containing these materials, pursuant to paragraph 3(a) and 3(b) of the Guidelines document.

5. The agreed levels of physical protection to be ensured by the competent national authorities in the use, storage and transportation of the materials listed in the attached table shall as a minimum include protection characteristics as follows:

CATEGORY III

Use and Storage within an area to which access in controlled.

Transportation under special precautions including prior arrangements among sender, recipient and carrier, and prior agreement between entities subject to the jurisdiction and regulation of supplier and recipient States, respectively, in case of international transport specifying time, place and procedures for transferring transport responsibility.

CATEGORY II

Use and Storage within a protected area to which access is controlled, i.e. an area under constant surveillance by guards or electronic devices, surrounded by a physical barrier with a limited number of points of entry under appropriate control, or any area with an equivalent level of physical protection.

Transportation under special precautions including prior arrangements among sender, recipient and carrier, and prior agreement between entities subject to the jurisdiction and regulation of supplier and recipient States, respectively, in case of international transport, specifying time, place and procedures for transferring transport responsibility.

CATEGORY I

Materials in this category shall be protected with highly reliable systems against unauthorized use as follows:

Use and Storage within a highly protected area, i.e. a protected area as defined for Category II above, to which, in addition, access is restricted to persons whose trustworthiness has been determined, and which is under surveillance by guards who are in close communication with appropriate response forces. Specific measures taken in this context should have as their objective the detection and prevention of any assault, unauthorized access or unauthorized removal of material;

Transportation under special precautions as identified above for transportation of Category II and III materials and, in addition, under constant surveillance by escorts and under conditions which assure close communication with appropriate response forces.

6. Suppliers should request identification by recipients of those agencies or authorities having responsibility for ensuring that levels of protection are adequately met and having responsibility for internally co-ordinating response/recovery operations in the event of unauthorized use or handling of protected materials. Suppliers and recipients should also designate points of contact within their national authorities to co-operate on matters of out-of-country transportation and other matters of mutual concern.

TABLE: CATEGORIZATION OF NUCLEAR MATERIAL

Material	Form	CATEGORY		
		I	II	III
1. Plutonium[a]	Unirradiated[b]	2 kg or more	Less than 2 kg but more than 500 g	500 g or less[c]
2. Uranium-235	Unirradiated[b]			
	- uranium enriched to 20% ^{235}U or more	5 kg or more	Less than 5 kg but more than 1 kg	1 kg or less[c]
	- uranium enriched to 10% ^{235}U but less than 20%		10 kg or more	Less than 10 kg[c]
	- uranium enriched above natural, but less than 10% ^{235}U[d]			10 kg or more
3. Uranium-233	Unirradiated[b]	2 kg or more	Less than 2 kg but more than 500 g	500 g or less[c]
4. Irradiated fuel			Depleted or natural uranium, thorium or low-enriched fuel (less than 10% fissile content)[e,f]	

[a] As identified in the Trigger List.

[b] Material not irradiated in a reactor or material irradiated in a reactor but with a radiation level equal to or less than 100 rads/hourat one metre unshielded.

[c] Less than a radiologically significant quantity should be exempted.

[d] Natural uranium, depleted uranium and thorium and quantities of uranium enriched to less than 10% not falling in Category III should be protected in accordance with prudent management practice.

[e] Although this level of protection is recommended, it would be open to States, upon evaluation of the specific circumstances, to assign a different category of physical protection.

[f] Other fuel which by virtue of its original fissile material content is classified as Category I or II before irradiation, may be reduced one category level while the radiation level from the fuel exceeds 100 rads/hour at one metre unshielded.

Section 2

DUAL-USE EQUIPMENT, MATERIAL AND RELATED TECHNOLOGY

BASIC PRINCIPLE

1. The transfers of equipment, material, or related technology identified in the attached list should not be authorized:
   - for use in a non-nuclear-weapon state in a nuclear explosive activity or an unsafeguarded nuclear fuel cycle activity, or
   - in general, when there is an unacceptable risk of diversion to such an activity, or when the transfers are contrary to the objective of averting the proliferation of nuclear weapons.

EXPLANATION OF TERMS

2. (a) "Nuclear explosive activity" includes research on or development, design, manufacture, construction, testing or maintenance of any nuclear explosive device or components or subsystems of such a device.

   (b) "Unsafeguarded nuclear fuel-cycle activity" includes research on or development, design, manufacture, construction, operation or maintenance of any reactor, critical facility, conversion plant, fabrication plant, reprocessing plant, plant for the separation of isotopes of source or special fissionable material, or separate storage installation, where there is no obligation to accept International Atomic Energy Agency (IAEA) safeguards at the relevant facility or installation, existing or future when it contains any source or special fissionable material; or any heavy water production plant where there is no obligation to accept IAEA safeguards on any nuclear material produced by or used in connection with any heavy water produced therefrom; or where any such obligation is not met.

ESTABLISHMENT OF EXPORT LICENSING PROCEDURES

3. In considering whether to authorize the transfer of equipment, material, and related technology identified in the attached list, Romanian authorities should exercise prudence in order to carry out the Basic Principle and should take relevant factors into account, including:

   (a) Whether the recipient state is a party to the Nuclear Non-Proliferation Treaty (NPT) or to the Treaty for the Prohibition of Nuclear Weapons in Latin America (Treaty of Tlatelolco), or to a similar international legally-binding nuclear non-proliferation agreement, and has an IAEA safeguards agreement in force applicable to all its peaceful nuclear activities;

   (b) Whether any recipient state that is not party to the NPT, Treaty of Tlatelolco, or a similar international legally- binding nuclear non-proliferation agreement has any facilities or installations listed in paragraph 2(b) above that are operational or being designed or constructed that are not, or will not be, subject to IAEA safeguards;

(c) Whether the equipment, material, or related technology to be transferred is appropriate for the stated end-use and whether that stated end-use is appropriate for the end-user;

(d) Whether the equipment, material, or related technology to be transferred is to be used in research on or development, design, manufacture, construction, operation, or maintenance of any reprocessing or enrichment facility;

(e) Whether governmental actions, statements, and policies of the recipient state are supportive of nuclear non-proliferation and whether the recipient state is in compliance with its international obligations in the field of non-proliferation;

(f) Whether the recipients have been engaged in clandestine or illegal procurement activities; and

(g) Whether a transfer has not been authorized to the end-user or whether the end-user has diverted for purposes inconsistent with these Guidelines any transfer previously authorized.

CONDITIONS FOR TRANSFERS

4. In the process of determining that the transfer will not pose any unacceptable risk of diversion, in accordance with the Basic Principle and to meet the objectives of these Guidelines, Romanian authorities should obtain, before authorizing the transfer and in a manner consistent with national law and practices, the following:

(a) a statement from the end-user specifying the uses and end-use locations of the proposed transfers; and

(b) an assurance explicitly stating that the proposed transfer or any replica thereof will not be used in any nuclear explosive activity or unsafeguarded nuclear fuel-cycle activity.

CONSENT RIGHTS OVER RETRANSFERS

5. Before authorizing the transfer of equipment, material, or related technology identified in the attached list to a country not adhering to the Guidelines, Romanian authorities should obtain assurance that their consent will be secured, in a manner consistent with their national law and practices, prior to any retransfer to a third country of the equipment, material, or related technology, or any replica thereof.

LIST OF NUCLEAR-RELATED DUAL-USE EQUIPMENT AND MATERIALS AND RELATED TECHNOLOGY

Note: The International System of Units (SI) is used in this Annex. In many places, the approximately equivalent physical quantity in English units is given in parentheses () after the SI quantity. In all cases the physical quantity defined in SI units should be considered the official recommended control value. However, some machine tool parameters are given in their customary units, which are not SI.

Commonly used abbreviations (and their prefixes denoting size) in this Annex are as follows:

A - ampere(s)
°C - degree(s) Celsius
Ci - curie(s)
cm^3 - cubic centimetre(s)
dB - decibel(s)
dBm - decibel referred to 1 milliwatt
g - gram(s); also, acceleration of gravity (9.81 m/second^2)
GBq - gigabecquerel(s)
GHz - gigahertz
Hz - hertz
J - joule(s)
K - kelvin
keV - thousand electron volt(s)
kg - kilogram(s)
kHz - kilohertz
kN - kilonewton(s)
kPa - kilopascal(s)
Kw - kilowatt(s)
m - meter(s)
MeV - million electron volt(s)
MHz - megahertz
MPa - megapascal(s)
MW - megawatt(s)
μF - microfarad(s)
μm - micrometer(s)
μs - microsecond(s)
mm - milimeter(s)
N - newton(s)
nm - nanometer(s)
ns - nanosecond(s)
nH - nanohenry(s)
ps - picosecond(s)
RMS - root mean square
TIR - total indicator reading
W - watt(s)

GENERAL NOTE

The following paragraphs are applied to the List of Nuclear-Related Dual-Use Equipment, Material, and Related Technology.

1. The description of any item on the List includes that item in either new or second-hand condition.

2. When the description of any item on the List contains no qualifications or specifications, it is regarded as including all varieties of that item. Category captions are only for convenience in reference and do not affect the interpretation of item definitions.

3. The object of these controls should not be defeated by the transfer of any non-controlled item (including plants) containing one or more controlled components when the controlled component or components are the principal element of the item and can feasibly be removed or used for other purposes.

   Note:
   In judging whether the controlled component or components are to be considered the principal element, governments should weigh the factors of quantity, value, and technological know-how involved and other special circumstances which might establish the controlled component or components as the principal element of the item being procured.

4. The object of these controls should not be defeated by the transfer of component parts. Each government will take such action as it can to achieve this aim and will continue to seek a workable definition for component parts, which could be used by all suppliers.

TECHNOLOGY CONTROL

The transfer of "technology" directly associated with any items in the List will be subject to as great a degree of scrutiny and control as will the equipment itself, to the extent permitted by national legislation.

Controls on "technology" transfer do not apply to information "in the public domain" or to "basic scientific research".

Note: The item on machine tools contains specific controls on technology.

STATEMENT OF UNDERSTANDING

The approval of any List item for export also authorizes the export to the same end user of the minimum technology required for the installation, operation, maintenance, and repair of the item.

DEFINITIONS

"Technology" - means specific information required for the "development", "production", or "use" of any item contained in the List. This information may take the form of "technical data" or "technical assistance".

"basic scientific research" - Experimental or theoretical work undertaken principally to acquire new knowledge of the fundamental principles of phenomena and observable facts, not primarily directed toward a specific practical aim or objective.

"development" - is related to all phases before "production" such as:

- design
- design research
- design analysis
- design concepts
- assembly and testing of prototypes
- pilot production schemes
- design data
- process of transforming design data into a product
- configuration design
- integration design
- layouts

"in the public domain" - "In the public domain", as it applies herein, means technology that has been made available without restrictions upon its further dissemination. (Copyright restrictions do not remove technology from being in the public domain.)

"production" - means all production phases such as:

- construction
- production engineering
- manufacture
- integration
- assembly (mounting)
- inspection
- testing
- quality assurance

"Specially designed software"

The minimum "operating systems", "diagnostic systems", "maintenance systems", and "application software" necessary to be executed on particular equipment to perform the function for which it was designed. To make other, incompatible equipment perform the same function requires:

(a) modification of this "software" or
(b) addition of "programs".

"technical assistance" - "Technical assistance" may take forms such as: instruction, skills, training, working knowledge, consulting services.

__Note:__ "Technical assistance" may involve transfer of "technical data".

"technical data" - "Technical data" may take forms such as blueprints, plans, diagrams, models, formulae, engineering designs and specifications, manuals and instructions written or recorded on other media or devices such as disk, tape, read-only memories.

"use" - Operation, installation (including on-site installation), maintenance (checking), repair, overhaul, and refurbishing.

ANNEX CONTENTS

1. INDUSTRIAL EQUIPMENT

1.1. Spin-forming and flow-forming machines..........1-1
1.2. "Numerical control units"... machine tools......1-1
1.3. Dimensional inspection systems..................1-1
1.4. Vacuum induction furnaces........................1-3
1.5. Isostatic presses................................1-3
1.6. Robots and end effectors........................1-4
1.7. Vibration test equipment........................1-4
1.8. Furnaces - arc remelt, electron bean, and plasma.1-5

2. MATERIALS

2.1. Aluminium, high-strength........................2-1
2.2. Beryllium..2-1
2.3. Bismuth (high purity)...........................2-1
2.4. Boron (isotopically enriched in boron-10).......2-1
2.5. Calcium (high purity)...........................2-1
2.6. Chlorine trifluoride............................2-1
2.7. Crucibles made of materials resistant to liquid actinide metals.......................2-1
2.8. Fibrous and filamentary materials...............2-2
2.9. Hafnium...2-2
2.10. Lithium (isotopically enriched in lithium-6)....2-2
2.11. Magnesium (high purity).........................2-3
2.12. Maraging steel, high strength...................2-3
2.13. Radium..2-3
2.14. Titanium alloys.................................2-3
2.15. Tungsten..2-3
2.16. Zirconium.......................................2-3

3. URANIUM ISOTOPE SEPARATION EQUIPMENT AND COMPONENTS

3.1. Electrolytic cells for fluorine production......3-1
3.2. Rotor and bellows equipment.....................3-1
3.3. Centrifugal multiplane balancing machines.......3-1
3.4. Filament winding machines.......................3-2
3.5. Frequency changers..............................3-2
3.6. Lasers, laser amplifiers, and oscillators.......3-2
3.7. Mass spectrometers and mass spectrometer ion sources.....................................3-4
3.8. Pressure measuring instruments, corrosion-resistant.............................3-4
3.9. Valves, corrosion-resistant.....................3-4
3.10. Superconducting solenoidal electromagnets.......3-4
3.11. Vacuum pumps....................................3-5
3.12. Direct current high-power supplies (100 V or greater)....................................3-5
3.13. High voltage direct current power supplies (20,000 V or greater)..........................3-5
3.14. Electromagnetic isotope separators..............3-5

4. HEAVY WATER PRODUCTION PLANT RELATED EQUIPMENT (Other Than Trigger List Items)

4.1. Specialized packings for water separation........4-1
4.2. Pumps for potassium amide/liquid ammonia.........4-1
4.3. Water-hydrogen sulfide exchange tray columns.....4-1
4.4. Hydrogen-cryogenic distillation columns..........4-1
4.5. Ammonia converters or synthesis reactors.........4-2

5. IMPLOSION SYSTEMS DEVELOPMENT EQUIPMENT

5.1. Flash x-ray equipment............................5-1
5.2. Multistage light gas guns/high-velocity guns.....5-1
5.3. Mechanical rotating mirror cameras...............5-1
5.4. Electronic streak and framing cameras and tubes..5-2
5.5. Specialized instrumentation for hydrodynamic experiments..5-2

6. EXPLOSIVES AND RELATED EQUIPMENT

6.1. Detonators and multipoint initiation systems.....6-1
6.2. Electronic components for firing sets............6-1
6.2.1. Switching devices..............................6-1
6.2.2. Capacitors.....................................6-2
6.3. Firing sets and equivalent high-current pulsers (for controlled detonators)........................6-2
6.4. High explosives relevant to nuclear weapons.......6-2

7. NUCLEAR TESTING EQUIPMENT AND COMPONENTS

7.1. Oscilloscopes....................................7-1
7.2. Photomultiplier tubes............................7-1
7.3. Pulse generators (high speed)....................7-1

8. OTHER

8.1 Neutron generator systems.........................8-1
8.2 General nuclear related equipment.................8-1
8.2.1. Remote manipulators............................8-1
8.2.2. Radiation shielding windows....................8-1
8.2.3. Radiation-hardened TV cameras..................8-1
8.3 Tritium, tritium compounds, and mixture...........8-1
8.4 Tritium facilities or plants and components therefor..8-1
8.5 Platinized carbon catalysts.......................8-1
8.6 Helium-3..8-2
8.7 Alpha-emitting radionuclides......................8-2

APPENDIX: DETAILED MACHINE TOOLS SPECIFICATIONS............A-1

ANNEX

LIST OF NUCLEAR-RELATED DUAL-USE EQUIPMENT AND MATERIALS AND RELATED TECHNOLOGY

1. INDUSTRIAL EQUIPMENT

1.1. Spin-forming and flow-forming machines which:

a. according to the manufacturer's technical specification, can be equipped with "numerical control" units or a computer control; and

b. with two or more axes that can be coordinated simultaneously for "contouring control",

and precision rotor-forming mandrels designed to form cylindrical rotors of inside diameter between 75 mm (3 in.) and 400 mm (16 in.) and specially designed software therefor.

Note: The only spin-forming machines controlled by this entry are those combining the function of spin-forming and flow-forming.

1.2. "Numerical control" units, specially designed "motion control boards" for "numerical control" applications on machine tools, "numerically controlled" machine tools, specially designed "software", and technology as follows.

Detailed specifications of the equipment are shown in the Appendix.

1.3. Dimensional inspection machines, devices, or systems, as follows, specially designed software therefor.

(a) Computer controlled or numerically controlled dimensional inspection machines having both of the following characteristics:
(1) two or more axes; and
(2) a one-dimensional length "measurement uncertainty" equal to or less (better) than $(1.25 + L/1000)\ \mu m$ tested with a probe of an "accuracy" of less (better) than $0.2\ \mu m$ (L is the measured length in millimiters) (Ref: VDI/VDE 2617 parts 1 and 2);

(b) Linear and angular displacement measuring devices, as follows:

- (1) linear measuring instruments having any of the following characteristics:
  - (i) non-contact type measuring systems with a "resolution" equal to or less (better) than 0.2 µm within a measuring range up to 0.2 mm;
  - (ii) linear variable differential transformer (LVDT) systems having both of the following characteristics:
    - (A) "linearity" equal to or less (better) than 0.1% within a measuring range up to 5 mm; *and*
    - (B) drift equal to or less (better) than 0.1% per day at a standard ambient test room temperature ±1 K; or
  - (iii) measuring systems that have both of the following characteristics:
    - (A) contain a "laser"; *and*
    - (B) maintain for at least 12 hours, over a temperature range of ±1 K around a standard temperature and a standard pressure:
      - (1) a "resolution" over their full scale of 0.1 µm or better; and
      - (2) with a "measurement uncertainty" equal to or less (better) than (0.2 + L/2000) µm (L is the measured length in millimeters); except measuring interferometer systems, without closed or open loop feedback, containing a "laser" to measure slide movement errors of machine tools, dimensional inspection machines, or similar equipment;
- (2) angular measuring instruments having an "angular position deviation" equal to or less (better) than 0.00025";

Note: The sub-item (b)(2) of this item does not control optical instruments, such as autocollimators, using collimated light to detect angular displacement of a mirror.

- (c) Systems for simultaneously linear-angular inspection of hemishells, having both of the following characteristics:
  - (1) "measurement uncertainty" along any linear axis equal to or less (better) than 3.5 µm per 5mm; *and*
  - (2) "angular position deviation" equal to or less than 0.02".

Note: Specially designed software for the systems described in paragraph (c) of this item includes software for simultaneous measurement of wall thickness and contour.

Technical Note 1: Machine tools that can be used as measuring machines are controlled if they meet or exceed the criteria specified for the machine tool function or the measuring machine function.

Technical Note 2: A machine described in this section, 1.3., is controlled if it exceeds the control threshold anywhere within its operating range.

Technical Note 3: The probe used in determining the measurement uncertainty of a dimensional inspection system shall be as described in VDI/VDE 2617 parts 2,3, and 4

Technical Note 4: All parameters of measurement values in this item represent plus/minus, i.e., not total band.

"Measurement uncertainty"

The characteristic parameter which specifies in what range around the output value the correct value of the measurable variable lies with a confidence level of 95%. It includes the uncorrected systematic deviations, the uncorrected backlash, and the random deviations (Reference: VDI/VDE 2617).

"Resolution"

The least increment of a measuring device; on digital instruments, the least significant bit (Reference: ANSI B-89.1.12).

"Linearity"

(Usually measured in terms of nonlinearity) is the maximum deviation of the actual characteristic (average of upscale and downscale readings), positive or negative, from a straight line so positioned as to equalize and minimize the maximum deviations.

"Angular position deviation"

The maximum difference between angular position and the actual, very accurately measured angular position after the workpiece mount of the table has been turned out of its initial position. (Reference: VDI/VDE 2617. Draft: "Rotary table on coordinate measuring machines.")

1.4. Vacuum or controlled environment (inert gas) induction furnaces capable of operation above 850° C and having induction coils 600 mm (24 in.) or less in diameter, and power supplies specially designed for induction furnaces with a power supply of 5 KW or more.

Technical Note: This entry does not control furnaces designed for the processing of semiconductor wafers.

1.5. **"Isostatic presses"** capable of achieving a maximum working pressure of 69 MPa (10,000 psi) or greater and having a chamber cavity with an inside diameter in excess of 152 mm (6 in.) and specially designed dies and models, and controls and "specially designed software" therefor.

Technical Notes:

(1) The inside chamber dimension is that of the chamber in which both the working temperature and the working pressure are achieved and does not include fixtures. That dimension will be the smaller of either the inside diameter of the pressure chamber or the inside diameter of the insulated furnace chamber, depending on which of the two chambers is located inside the other.

(2) **"Isostatic presses"**
Equipment capable of pressurizing a closed cavity through various media (gas, liquid, solid particles, etc.) to create equal pressure in all directions within the cavity upon a workpiece or material.

1.6. **"Robots"** and **"end-effectors"** having either of the following characteristics:

(a) Specially designed to comply with national safety standards applicable to handling high explosives (for example, meeting electrical code ratings for high explosives); or

(b) Specially designed or rated as radiation hardened to withstand greater than 5 x 10^4 grays (Si) (5 x 10^6 rad (Si)) without operational degradation;

and specially designed controllers and "specially designed software" therefor.

Technical Notes:

(1) **"Robot"**
A manipulation mechanism, which may be of the continuous path or of the point-to point variety, may use "sensors", and has all of the following characteristics:
- (a) is multifunctional;
- (b) is capable of positioning or orienting material, parts, tools, or special devices through variable movements in three-dimensional space;
- (c) incorporates three or more closed or open loop servo-devices which may include stepping motors; *and*
- (d) has "user-accessible programmability" by means of teach/playback method or by means of an electronic computer which may be a programmable logic controlled ,i.e., without mechanical intervention.

N.B.:
The above definition does not include the following devices:

(a) Manipulation mechanisms which are only manually/teleoperator controllable:

(b) Fixed sequence manipulation mechanisms which are automated moving devices operating according to mechanically fixed programmed motions. The program is mechanically limited by fixed stops, such as pins or cams. The sequence of motions and the selections of paths or angles are not variable or changeable by mechanical, electronic, or electrical means;

(c) Mechanically controlled variable sequence manipulation mechanisms which are automated moving devices operating according to mechanically fixed programmed motions. The program is mechanically limited by fixed, but adjustable, stops such as pins or cams. The sequence of motions and the selection of paths or angles are variable within the fixed program pattern. Variations of modifications of the program pattern (e.g., changes of pins or exchange of cams) in one or more motion axes are accomplished only through mechanical operations;

(d) Non-servo-controlled variable sequence manipulation mechanisms which are automated moving devices, operating according to mechanically fixed programmed motions. The program is variable but the sequence proceeds only by the binary signal from mechanically fixed electrical binary devices or adjustable stops;

(e) Stacker cranes defined as Cartesian coordinate manipulator systems manufactured as an integral part of a vertical array of storage bins and designed to access the contents of those bins for storage or retrieval.

(2) **"End-effectors"**
"End-effectors" include grippers, "active tooling units", and any other tooling that is attached to the baseplate on the end of a "robot" manipulator arm.

(3) The definition in (a) above is not designed to control robots specially designed for nonnuclear industrial applications such as automobile paint-spraying booths.

1.7. Vibration test equipment using digital control techniques and feedback or closed loop test equipment and software therefor capable of vibrating a system at 10 g RMS or more between 20 Hz and 2000 Hz, imparting forces of 50 kN (11,250 lbs) or greater.

1.8. Vacuum and controlled atmosphere metallurgical melting and casting furnaces as follows; and specially configured computer control and monitoring systems and "specially designed software" therefor:

(a) Arc remelt and casting furnaces with consumable electrode capacities between 1000 cm^3 and 20,000 cm^3 and capable of operating with melting temperature above 1700° C,

(b) Electron beam melting and plasma atomization and melting furnaces with a power of 50 kW or greater and capable of operating with melting temperatures above 1200° C.

2. MATERIALS

2.1. Aluminium alloys capable of an ultimate tensile strength of 460 MPa (0.46×10^9 N/m^2) or more at 293 K (20°C), in the form of tubes or solid forms (including forgings) with an outside diameter of more than 75 mm (3 in.).

Technical Note: The phrase "capable of" encompasses aluminium alloys before or after heat treatment.

2.2. Beryllium as follows: metal, alloys containing more than 50% of beryllium by weight, compounds containing beryllium, and manufactures therefor, except:

(a) Metal windows for X-ray machines;

(b) Oxide shapes in fabricated or semi-fabricated forms specially designed for electronic component parts or as substrates for electronic circuits.

Technical Note: This control applies to waste and scrape containing beryllium as defined here.

2.3. High-purity (99.99% or greater) bismuth with very low silver content (less than 10 parts per million).

2.4. Boron and boron compounds, mixtures, and loaded materials in which the boron-10 isotope is more than 20% by weight of the total boron content.

2.5. Calcium (high purity) containing both less than 1000 parts per million by weight of metallic impurities other than magnesium and less than 10 parts per million of boron.

2.6. Chlorine Trifluoride (CIF_3).

2.7. Crucibles made of materials resistant to liquid actinide metals, as follows:

(a) Crucibles with a volume of between 150 ml and 8 liters and made of or coated with any of the following materials having a purity of 98% or greater:
(i) Calcium fluoride (CaF_2),
(ii) Calcium zirconate (metazirconate) (Ca_2ZrO_3),
(iii) Cerium sulfide (Ce_2S_3),
(iv) Erbium oxide (erbia) (Er_2O_3),
(v) Hafnium oxide (hafnia) (HfO_2),
(vi) Magnesium oxide (MgO),
(vii) Nitrided niobium-titanium-tungsten alloy (aproximately 50%Nb, 30%Ti, 20%W),
(viii) Yttrium oxide (yttria) (Y_2O_3),
(ix) Zirconium oxide (zirconia) (ZrO_2).

(b) Crucibles with a volume of between 50 ml and 2 liters and made of or lined with tantalum, having a purity of 99.9% or greater.

(c) Crucibles with a volume of between 50 ml and 2 liters and made of or lined with tantalum (having a purity of 98% or greater) coated with tantalum carbide, nitride, or boride (or any combination of these).

2.8. (a) Carbon or aramid "fibrous and filamentary" materials having a "specific modulus" of 12.7 x 10^6 m or greater or a "specific tensile strength" of 23.5 x 10^4 m or greater; or

(b) Glass "fibrous and filamentary" materials having a "specific modulus" of 3,18 x 10^6 m or greater and a "specific tensile strength" of 7.62 x 10^4 m or greater.

(c) Composite structures in the form of tubes with an inside diameter of between 75 mm (3 in.) and 400 mm (16 in.) made with "fibrous and filamentary" materials controlled in (a) above.

__Technical Note:__

(a) The term "fibrous and filamentary materials" includes continuous monofilaments, continuous yarns, and tapes.

(b) "Specific modulus" is the Young's modulus in N/m^2 divided by the specific weight in N/m^3 when measured at a temperature of 23 ±2° C and a relative humidity of 50 ±5%;

(c) "Specific tensile strength" is the ultimate tensile strength in N/m^2 divided by the specific weight in N/m^3 when measured at a temperature of 23 +/- 2° C and a relative humidity of 50 +/- 5%;

2.9. Hafnium of the following description: metal, alloys, and compounds of hafnium containing more than 60% hafnium by weight and manufactures thereof.

2.10. Lithium (isotopically enriched in lithium-6) as follows:

(a) Metal hydrides or alloys containing lithium enriched in the 6 isotope (^6Li) to a concentration higher than the one existing in nature (7.5% on an atom percentage basis);

(b) Any other materials containing lithium enriched in the 6 isotope (including compounds, mixtures, and concentrates), *except ^{6}Li incorporated in thermoluminescent dosimeters.*

2.11. Magnesium (high purity) containing both less than 200 parts per million by weight of metallic impurities other than calcium and less than 10 parts per million of boron.

2.12. Maraging steel capable of an ultimate tensile strength of 2050 MPa (2.050 x 10^9 N/m^2) (300,000 lb/in.^{2}) or more at 293 K (20°C), *except forms in which no linear dimension exceeds 75 mm.*

__Technical Note:__ The phrase "capable of" encompasses maraging steel before or after heat treatment.

2.13. Radium-226, *except radium contained in medical applicators.*

2.14. Titanium alloys capable of an ultimate tensile strength of 900 MPa (0.9 x 10^9 N/m^2) (130,500 lb/in.^{2}) or more at 293 K (20° C) in the form of tubes or solid forms (including forgings) with an outside diameter of mare than 75 mm (3 in.).

__Technical Note:__ The phrase "capable of" encompasses titanium alloys before or after heat treatment.

2.15. Tungsten, as follows: parts made of tungsten, tungsten carbide, or tungsten alloys (greater than 90% tungsten) having a mass greater than 20 Kg and a hollow cylindrical symmetry (including cylinder segments) with an inside diameter greater than 100 mm (4 in.) but less than 300 mm (12 in.), *except parts specifically designed for use as weights or gamma-ray collimators.*

2.16. Zirconium as follows: metal, alloys containing more than 50% zirconium by weight, and compounds in which the ratio of hafnium content to zirconium content is less than 1 part of 500 parts by weight, and manufactures wholly thereof; *except zirconium in the form of foil having a thickness not exceeding 0.10 mm (0.004 in.).*

__Technical Note:__ This control applies to waste and scrap containing zirconium as defined here.

3. URANIUM ISOTOPE SEPARATION EQUIPMENT AND COMPONENTS

3.1. Electrolytic cells for fluorine production with a production capacity greater than 250 g of fluorine per hour.

3.2. Rotor fabrication and assembly equipment and bellow-forming mandrels and dies, as follows:

(a) Rotor assembly equipment for assembly of gas centrifuge rotor tube sections, baffles, and end caps. Such equipment includes precision mandrels, clamps, and shrink fit machines.

(b) Rotor straightening equipment for alignment of gas centrifuge rotor tube sections to a common axis. (Note: Normally such equipment will consist of precision measuring probes linked to a computer that subsequently controls the action of, for example, pneumatic rams used for aligning the rotor tube sections.)

(c) Bellows-forming mandrels and dies for producing single-convolution bellows (bellow made of high-strength aluminium alloys, maraging steel, or high-strength filamentary materials). The bellows have all the following dimensions:

(1) 75 mm to 400 mm (3 in. to 16 in.) inside diameter;
(2) 12.7 mm (0.5 in.) or more in length; and
(3) single convolution depth more than 2 mm (0.08 in.).

3.3. Centrifugal multiplane balancing machines, fixed or portable, horizontal or vertical, as follows:

(a) Centrifugal balancing machines designed for balancing flexible rotors having a length of 600 mm or more and having all of the following characteristics:
(1) a swing or journal diameter of 75 mm or more;
(2) mass capability of from 0.9 to 23 Kg (2 to 50 lb.); and
(3) capable of balancing speed of revolution more than 5000 rpm;

(b) Centrifugal balancing machines designed for balancing hollow cylindrical rotor components and having all of the following characteristics:
(1) a journal diameter of 75 mm or more;
(2) mass capability of from 0.9 to 23 Kg (2 to 50 lb.);
(3) capable of balancing to a residual imbalance of 0.010 Kg·mm/Kg per plane or better; and
(4) belt drive type;

and "specially designed software" therefor.

3.4. Filament winding machines in which the motions for positioning, wrapping, and winding fibers are coordinated and programmed in two or more axes, specially designed to fabricate composite structures or laminates from fibrous and filamentary materials and capable of winding cylindrical rotors of diameter between 75 mm (3 in.) and 400 mm (16 in.) and lengths of 600 mm (24 in.) or greater; coordinating and programming controls therefor; precision mandrels; and "specially designed software" therefor.

3.5. Frequency changers (also known as converters or inverters) or generators having all of the following characteristics:

(a) A multiphase output capable of providing a power of 40 W or more;

(b) Capable of operating in the frequency range between 600 and 2000 Hz;

(c) Total harmonic distortion below 10%; and

(d) Frequency control better than 0.1%.

except such frequency changers specially designed or prepared to supply "motor stators" (as defined below) and having the characteristics listed in (b) and (d) above, together with a total harmonic distortion of less than 2% and an efficiency of greater than 80%.

Definition:

"Motor stators": specially designed or prepared ring-shaped stators for high-speed multiphase AC hysteresis (or reluctance) motors for synchronous operation within a vacuum in the frequency range of 600-2000 Hz and a power range of 50-1000 VA. The stators consist of multiphase windings on a laminated low-loss iron core comprising thin layers typically 2.0 mm (0.08 in.) thick or less.

3.6. Lasers, laser amplifiers, and oscillators as follows:

(a) Cooper vapor laser with 40 W or greater average output power operating at wavelengths between 500 nm and 600 nm;

(b) Argon ion lasers with greater than 40 W average output operating at wavelengths between 400 nm and 515 nm;

(c) Neodymium-doped (other than glass) lasers as follows:

(1) having an output wavelength between 1000 nm and 1100 nm, being pulse-excited and Q-switched with a pulse duration equal to or greater than 1 ns, and having either of the following:
   (a) A single-transverse mode output having an average output power exceeding 40 W;
   (b) A multiple-transverse mode output having an average output power exceeding 50 W;

(2) operating at a wavelength between 1000 nm and 1100 nm and incorporating frequency doubling giving an output wavelength between 500 nm and 550 nm with an average power at the doubled frequency (new wavelength) of greater than 40 W;

(d) Tunable pulsed single-mode dye oscillators capable of an average power output of greater than 1 W, a repetition rate greater than 1 kHz, a pulse less than 100 ns, and a wavelength between 300 nm and 800 nm;

(e) Tunable pulsed dye laser amplifiers and oscillators, *except single mode oscillators*, with an average power output of greater than 30 W, a repetition rate greater than 1 kHz, a pulse width less than 100 ns, and a wavelength between 300 nm and 800 nm;

(f) Alexandrite lasers with a bandwidth of 0.005 nm or less, a repetition rate of greater than 125 Hz, and an average power output greater than 30 W operating at wavelengths between 720 nm and 800 nm;

(g) Pulsed carbon dioxide lasers with a repetition rate greater than 250 Hz, an average power output of greater than 500 W, and a pulse of less than 200 ns operating at wavelengths between 9000 nm and 11,000 nm;

N.B. This specification is not intended to control the higher power (typically 1 to 5 kW) industrial CO_2 lasers used in applications such as cutting and welding, as these latter lasers are either continuous wave or are pulsed with a pulse width more than 200 ns.

(h) Pulsed excimer lasers (XeF, XeCl, KrF) with a repetition rate greater than 250 Hz and an average power output of greater than 500 W operating at wavelengths of between 240 and 360 nm;

(i) Para-hydrogen Raman shifters designed to operate at 16 μm output wavelength and at a repetition rate greater than 250 Hz.

Technical Note: Machine tools, measuring devices, and associated technology that have the potential for use in the nuclear industry are controlled under items 1.2 and 1.3 of this list.

3.7 Mass spectrometers capable of measuring ions of 230 atomic mass units or greater and having a resolution of better than 2 parts in 230, and ion sources therefor as follows:

(a) Inductively coupled plasma mass spectrometers (ICP/MS);

(b) Glow discharge mass spectrometers (GDMS);

(c) Thermal ionization mass spectrometers (TIMS);

(d) Electron bombardment mass spectrometers which have a source chamber constructed from or lined with or plated with materials resistant to UF_6;

(e) Molecular beam mass spectrometers as follows:
  (1) which have a source chamber constructed from or lined or plated with stainless steel or molybdenum and have a cold trap capable of cooling to 193 K (-80°C) or less; or
  (2) which have a source chamber constructed from or lined with or plated with materials reistent to UF_6; or

(f) Mass spectrometers equipped with a microfluorination ion source designed for use with actinides or actinide fluorides;

except

specially designed or prepared magnetic or quadrupole mass spectrometers capable of taking "on-line" samples of feed, product, or tails from UF_6 gas streams and having all of the following characteristics:
  (1) Unit resolution for mass greater than 320;
  (2) Ion sources constructed of or lined with nichrome or monel or nickel-plated;
  (3) Electron bombardment ionization sources;
  (4) Having a collector system suitable for analysis.

3.8. Instruments capable of measuring pressures up to 13 kPa (2psi, 100 torr) to an accuracy of better than 1% (full-scale), with corrosion-resistant pressure-sensing elements constructed of nickel, nickel alloys, phosphor bronze, stainless steel, aluminium, or aluminium alloys.

3.9. Valves 5 mm (0.2 in.) or greater in diameter, with a bellows seal, wholly made of or lined with aluminium, aluminium alloy, nickel, or alloy containing 60% or more nickel, either manually or automatically operated.

3.10. Superconducting solenoidal electromagnets with all of the following characteristics:

(a) capable of creating magnetic fields of more than 2 teslas (20 kilogauss);

(b) with an L/D (length divided by inner diameter) greater than 2;

(c) with an inner diameter of more than 300 mm; and

(d) with a magnetic field uniform to better than 1% over the central 50% of the inner volume.

Note:

The item does not cover magnets specially designed for and exported as parts of medical nuclear magnetic resonance (NMR) imaging systems. It is understood that the wording "as part of" does not necessarily mean physical part in the same shipment. Separate shipments from different sources are allowed, provided the related export documents clearly specify the "part of" relationship.

3.11. Vacuum pumps with an input throat of 38 cm (15 in.) or greater with a pumping speed of 15,000 liters/second or greater and capable of producing an ultimate vacuum better than 10^{-4} Torr (0.76×10^{-4} mbar).

Technical Note: The ultimate vacuum is determined at the input pump with the input of the pump blocked off.

3.12. Direct current high-power supplies capable of continuously producing, over a time period of 8 hours, 100 V or greater with current output of 500 amps or greater and with current or voltage regulation better than 0.1%.

3.13. High-voltage direct current power supplies capable of continuously producing, over a time period of 8 hours, 20,000 V or greater with current output of 1 amp or greater and with current or voltage regulation better than 0.1%.

3.14. Electromagnetic isotope separators, designed for or equipped with, single or multiple ion source capable of providing a total ion beam current of 50 mA or greater.

Notes:

1. This entry control separators capable of enriching stable isotopes as well as those for uranium. A separator capable of separating the isotopes of lead with a one-mass unit difference is inherently capable of enriching the isotopes of uranium with a three-unit mass difference.

2. This entry includes separators with the ion sources and collectors both in the magnetic field and those configurations in which they are external to the field.

3. A single 50 mA ion source will produce less than 3 g of separated HEU per year from natural abundance feed.

4. HEAVY WATER PRODUCTION PLANT RELATED EQUIPMENT (Other Than Trigger List Items)

4.1. Specialized packings for use in separating heavy water from ordinary water and made of phosphor bronze mesh or copper (both chemically treated to improve wettability) and designed for use in vacuum distillation towers.

4.2. Pumps circulating solutions of diluted or concentrated potassium amide catalyst in liquid ammonia (KNH_2/NH_3), with all of the following characteristics:

(a) airtight (ie., hermetically sealed);
(b) for concentrated potassium amide solutions (1% or greater), operating pressure of 1.5-60 Mpa [15-600 atmospheres (atm)]; for dilute potassium amide solutions (less than 1 %), operating pressure of 20-60 Mpa (200-600 atm); and
(c) a capacity greater than 8.5 m^3/h (5 cubic feet per minute).

4.3. Water-hydrogen sulfide exchange tray columns constructed from fine carbon steel (such as ASTM A516) with a diameter of 1.8 m (6 ft.) or greater to operate at a nominal pressure of 2 Mpa (300 psi) or greater, except columns which are specially designed or prepared for the production of heavy water. Internal contactors of the columns are segmented trays with an effective assembled diameter of 1.8 (6 ft.) or greater ,such as sieve trays, valve trays, bubble cap trays, and turogrid trays designed to facilitate countercurrent contacting and constructed of materials resistant to corrosion by hydrogen sulfide/water mixtures, such as 304L or 316 stainless steel.

4.4 Hydrogen-cryogenic distillation columns having all of the following applications:

(a) designed to operate with internal temperatures of -238°C (35 K) or less ;

(b) designed to operate at internal pressure of 0.5 to 5 MPa (5 to 50 atmospheres);

(c) constructed of fine-grain stainless steel of the 300 series with low sulfur content or equivalent cryogenic and H_2- compatible materials; and

(d) with internal diameters of 1 m or greater and effective lengths of 5 m or greater.

4.5. Ammonia synthesis convertors, ammonia synthesis units in which the synthesis gas (nitrogen and hydrogen) is withdrawn from an ammonia/hydrogen high-pressure exchange column and the synthesized ammonia is returned to said column.

5. IMPLOSION SYSTEMS DEVELOPMENT EQUIPMENT

5.1. Flash x-ray generators or pulsed electron accelerators with peak energy of 500 keV or greater, as follows, *except accelerators that are component parts of devices designed for purposes other than electron beam or x-ray radiation (electron microscopy, for example) and those designed for medical purposes.*

(a) Having an accelerator peak electron energy of 500 keV or greater but less than 25 MeV and with a figure of merit (K) of 0,25 or greater, where **K** is defined as:

$$K = 1.7 \times 10^{3} V^{2.65} Q,$$

where **V** is the peak electron energy in million electron volts and **Q** is the total accelerated charge in coulombs if the accelerator beam pulse duration is less than or equal to 1 μs; if the accelerator beam pulse duration is greater than 1 μs, Q is the maximum accelerated charge in 1 μs [Q equals the integral of **i** with respect to **t**, over the lesser of 1 μs or the time duration of the beam pulse (Q = Sidt), where **i** is beam current in amperes and **t** is time in seconds] or,

(b) Having an accelerator peak electron energy of 25 MeV or greater and a peak power greater than 50 MW. [Peak power = (peak potential in volts) x (peak beam current in amperes).]

Technical Note:

Time duration of the beam pulse - In machines, based on microwave accelerating cavities, the time duration of the beam pulse is the lesser of 1 μs or the duration of the bunched beam packet resulting from one microwave modulator pulse.

Peak beam current - In machines based on microwave accelerating cavities, the peak beam current is the average current in the time duration of a bunched beam packet.

5.2. Multistage light gas guns or other high-velocity gun systems (coil, electromagnetic, electrothermal, or other advanced systems) capable of accelerating projectiles to 2 Km per second or greater.

5.3. Mechanical rotating mirror cameras

Mechanical framing cameras with recording rates greater than 225,000 frames per second; streak cameras with writing speeds greater than 0.5 mm per microsecond; and parts, including specially designed synchronizing electronics and specially designed rotor assemblies (consisting of turbines, mirrors, and bearings).

5.4. Electronic streak and framing cameras and tubes as follows:

(a) Electronic streak cameras capable of 50 ns or less time resolution and streak tubes therefor;

(b) Electronic (or electronically shuttered) framing cameras capable of 50 ns or less frame exposure time;

(c) Framing tubes and solid-state imaging devices for use with cameras controlled in sub-item (b) above, as follows:

(1) proximity focused image intensifier tubes having the photocathode deposited on a transparant conductive coating to decrease photocathode sheet resistance;
(2) gate silicon intensifier target (SIT) vidicon tubes, where a fast system allows gating the photoelectrons from the photocathode before they ???impinge on the SIT plate;
(3) Kerr or pockel cell electro-optical shuttering; or
(4) Other framing tubes and solid-state imaging devices having a fast-image gating time of less than 50 ns specially designed for cameras controlled by sub-item (b) above.

5.5. Specialized instrumentation for hydrodynamic experiments as follows:

(a) Velocity interferometers for measuring velocities in excess of 1 km per second during time intervals less than 10 μs. (VISARs, Doppler laser interferometers, DLIs, etc.);

(b) manganin gauges for pressures greater than 100 kilobars; or

(c) quartz pressure transducers for greater than 100 kilobars.

6. EXPLOSIVES AND RELATED EQUIPMENT

6.1. Detonators and multipoint initiation systems (exploding bridge wire, slapper, etc.)

(a) Electrically driven explosive detonators as follows:

(1) exploding bridge (EB)
(2) exploding bridge wire (EBW);
(3) slapper; and
(4) exploding foil initiators (EFI).

(b) Arrangements using single or multiple detonators designed to nearly simultaneously initiate an explosive surface (over greater than 5000 mm^2) from a single firing signal (with an initiation timing spread over the surface of less than 2,5 µm).

Description clarification: The detonators of concern all utilize a small electrical conductor (bridge, bridge wire, or foil) that explosively vaporizes when a fast, high-current electrical pulse is passed through it. In nonslapper types, the exploding conductor starts a chemical detonation in a contacting high-explosive material such as PETN (pentaerythritoltetranitrate). In slapper detonators, the explosive vaporization of the electrical conductor drives a "flyer" or "slapper" across a gap, and the impact of the slapper on an explosive starts a chemical detonation. The slapper in some designs is driven by magnetic force. The term "exploding foil" detonator may refer to either an EB or a slapper-type detonator. Also, the word "initiator" is sometimes used in place of the word "detonator".

Detonators using only primary explosives, such as lead azide, are not subject to control.

6.2. Electronic components for firing sets (switching devices and pulse discharge capacitors).

6.2.1. Switching devices

(a) Cold-cathode tubes (including gas krytron tubes and vacuum spryton tubes) whether gas filled or not, operating similarly to a spark gap, containing three or more electrodes, and having all of the following characteristics:

(1) Anode peak voltage rating of 2500 V or more,
(2) Anode peak current rating of 100 A or more,
(3) Anode delay time having of 10 µs or less, and

(b) Triggered spark-gaps having an anode delay time of 15 µs or less and rated for a peak current of 500 A or more;

(c) Modules or assemblies with a fast switching function having all the following characteristics:

  (1) Anode peak voltage rating grater than 2000 V;
  (2) Anode peak current rating of 500 A or more, and
  (3) turn-on time of 1 μs or less

6.2.2 Capacitors with the following characteristics:

  (a) Voltage rating greater than 1.4 kV, energy storage greater than 10 J, capacitance than 0.5 μF, and series inductance less than 50 nH, or

  (b) Voltage rating greater than 750 V, capacitance greater than 0.25 μF, and series inductance less than 10 nH.

6.3. Firing sets and equivalent high-current pulse generators (for controlled detonators), as follows:

(a) Explosive detonator firing sets designed to drive multiple controlled detonators covered under item 6.1. above;

(b) Modular electrical pulse generators (pulsers) designed for portable, mobile, or ruggedized use (including xenon flash-lamp drives) having all the following characteristics:

  (1) capable of delivering their energy in less than 15 μs;

  (2) having an output greater than 100 A;

  (3) having a rise time of less than 10 μs into loads of less than 40 ohms. (Rise time is defined as the time interval from 10% to 90% current amplitude when driving a resistive load);

  (4) enclosed in a dust-tight enclosure;

  (5) no dimension greater than 25.4 cm (10 in.);

  (6) weight less than 25 Kg (55 lb.); and

  (7) specified for use over an extended temperature range (-50°C to 100°C) or specified as suitable for aerospace use.

6.4. High explosives or substances or mixtures containing more than 2% of any of the following;

(a) Cyclotetramethylenetetranitramine (HMX);

(b) Cyclotrimethylenetrinitramine (RDX);

(c) Triaminotrinitrobenzene (TATB)

(d) Any explosive with a crystal density greater than 1.8 g/cm^3 and having a detonation velocity greater than 8000 m/s; or

(e) Hexanitrostilbene (HNS).

7. NUCLEAR TESTING EQUIPMENT AND COMPONENTS

7.1 Oscilloscopes and transient recorders and specially designed components as follows: plug-in units, external amplifiers, pre-amplifiers, sampling devices, and cathode ray tubes for analog oscilloscopes.

(a) Non-modular analog oscilloscopes having a "bandwidth" of 1 GHz or greater;

(b) Modular analog oscilloscope systems having either of the following characteristics:

(i) a mainframe with a "bandwidth" of 1 GHz or greater; or

(ii) plug-in modules with an individual "bandwidth" of 4 GHz or greater;

(c) Analog sampling oscilloscopes for the analysis of recurring phenomena with an effective "bandwidth" greater than 4 GHz;

(d) Digital oscilloscopes and transient recorders, using analog-to-digital conversion techniques, capable of storing transients by sequentially sampling single-shot inputs at successive intervals of less than 1 ns (greater than 1 giga-sample per second), digitizing to 8 bits or greater resolution and storing 256 or more samples.

Technical Note: "Bandwidth" is defined as the band of frequencies over which the deflection on the cathode ray tube does not fall below 70.7% of that at the maximum point measured with a constant input voltage to the oscilloscope amplifier.

7.2. Photomultiplier tubes with a photocathode area of greater than 20 cm^2 having an anode pulse rise time of less than 1 ns.

7.3. High-speed pulse generators with output voltages greater than 6 V into a less than 55 ohm resistive load, and with pulse transition times less than 500 ps (defined as the time interval between 10% and 90% voltage amplitude).

8. OTHER

8.1. Neutron generator systems, including tubes, designed for operation without an external vacuum system and utilizing electrostatic acceleration to induce a tritium-deuterium nuclear reaction.

8.2. Equipment related to nuclear material handing and processing and to nuclear reactors as follows:

8.2.1. Remote manipulators that provide mechanical translation of human operator actions by electrical, hydraulic, or mechanical means to an operating arm and terminal fixture that can be used to provide remote actions in radiochemical separation operations and "hot cells". The manipulators have a capability to penetrate 0.6 m or more (2ft. or more) of cell wall or, alternatively, bridge over the top of a cell wall with a thickness of 0.6 m or more (2 ft. or more);

8.2.2. High-density (lead glass or other) radiation shielding windows greater than 0.3 m (1 ft.) on a side and with a density greater than 3 g/cm^3 and a thickness of 100 mm or greater; and specially designed frames therefor;

8.2.3. Radiation-hardened TV cameras specially designed or rated as radiation hardened to withstand greater than 5 x 10^4 grays (SI) (5 x 10^6 rad (SI)) without operational degradation and specially designed lenses used therein.

8.3. Tritium, tritium compounds, and mixtures containing tritium in which the ratio of tritium to hydrogen by atoms exceeds 1 part to 1000, *except a product or device containing not more than 40 Ci of tritium in any chemical or physical form.*

8.4. Facilities or plants for the production, recovery, extraction, concentration, or handling of tritium, and equipment as follows;

(a) Hydrogen or helium refrigeration units capable of cooling to -250° C (23 K) or less, with heat removal capacity greater than 150 watts, or

(b) Hydrogen isotope storage and purification systems using metal hydrides as the storage, or purification medium.

8.5. Platinized catalysts specially designed or prepared for promoting the hydrogen isotope exchange reaction between hydrogen and water for the recovery of tritium from heavy water or for the production of heavy water.

8.6. Helium in any form isotopically enriched in the helium isotope, whether or not mixed with other materials or contained in any equipment or device, *except products or devices containing less than 1 g of helium-3.*

8.7. Alpha-emitting radionuclides and equipment containing such radionuclides as follows:

All alpha-emitting radionuclides having an alpha half-life of 10 days or greater but less than 200 years, including compounds and mixtures containing these radionuclides with a total alpha activity of 1 curie per kilogram (37 GBq/Kg) or greater, *except for devices containing less than 100 millicuries (3,7 GBq) of alpha activity per device.*

ANNEX APPENDIX: Detailed Specifications for Machine-Tools (Item 1.2. in List of Nuclear Dual-Use Export Controls)

1.2. "Numerical control" units, specially designed " motion control boards" for "numerical control" applications on machine tools, "numerical controlled" machine tools, specially designed " software" , and technology as follows.

(a) **"Numerical control"** units for machine tools, as follows:
- (1) Having more than four interpolating axes that can be coordinated simultaneously for "contouring control" or
- (2) Having two, three, or four interpolating axes that can be coordinated simultaneously for "contouring control" and one or more of the following conditions are fulfilled:
  - (i) Capable of "real-time processing" of data to modify the tool path during the machining operation by automatic calculation and modification of "part program" data for machining into or more axes by means of measuring cycles and axes to source data;
  - (ii) Capable of receiving directly (on-line) and processing computer-aided design (CAD) data for internal preparation of machine instructions; or
  - (iii) Capable, without modification, according to the manufacturer's technical specifications, of accepting additional boards that would permit increasing the number of interpolating axes that can be coordinated simultaneously for "contouring control" above the control levels, even if they do not contain these additional boards.

(b) **"Motion control boards"** specially designed for machine tools having one or more of the following characteristics:
- (1) Providing interpolation in more than four axes;
- (2) Capable of "real time processing" described in (a)(2)(i); or
- (3) Capable of receiving and processing CAD data as described in (a)(2)(ii) above.

Note 1: Subitems (a) and (b) do not control "numerical control" units and "motion" control boards" if

- (a) Modified for and incorporated in uncontrolled machines; or
- (b) Specially designed for uncontrolled machines.

Note 2: "Software" (including documentation) for "numerical control" units that may be exported must be:

- (a) In machine executable form only; and
- (b) Limited to the minimum necessary for the use (i.e., installation, operation, and maintenance) of these units.

(c) **Machine tools**, as follows, for removing or cutting metals, ceramics, or composites, which, according to the manufacturer's technical specifications, can be equipped with electronic devices for simultaneous "contouring control" in two or more axes:

Technical Note:

1. The c-axis on jig grinders used to maintain grinding wheels normal to the work surfaces is not considered. a contouring rotary axis.
2. Not counted in the total number of contouring axes are secondary parallel contouring axes, e.g., a secondary rotary axis, the center line of which is parallel to the primary rotary axis.
3. Axis nomenclature shall be in accordance with International Standard ISO-841, "Numerical Control Machines Axis Motion Nomenclature".
4. Rotary axes do not necessarily have to rotate over 360°. A rotary axis can be driven by a linear device, e.g., a screw or a rack-and-pinion.

(1) Machine tools for turning, grinding, milling, or any combination thereof that:

(i) Have two or more axes that can be coordinated simultaneously for "contouring control"; *and*

(ii) Have any of the following characteristics:

(A) Two or more contouring rotary axes:

(B) One or more contouring "tilting spindles";

Note: (c)(1)(ii)(B) applies to machine tools for grinding or milling only.

(C) "Camming" (axial displacement) in one revolution of the spindle less (better) than 0.0006 mm total indicator reading (TIR);

Note: (c)(1)(ii)(C) applies to machine tools for turning only.

(D) "Run out" (out-of-true running) in one revolution of the spindle less (better) than 0.0006 TIR.

(E) The "positioning accuracies" , with all compensations available, are less (better) than:

(1) 0.001" on any rotary axis

(2) (a) 0.004 mm along any linear axis (overall positioning) for grinding machines;

(b) 0.006 mm along any linear axis (overall positioning) for milling or turning machines.

Note: (c)(1)(ii)(E)(2)(b) does not control milling or turning machine tools with a positioning accuracy along one linear axis, with all compensations available, equal to or greater (worse) than 0.005 mm.

Notes: 1. Sub-item (c) does not control cylindrical external, internal, and external-internal grinding machines having all of the following characteristics:
   - (a) Not centerless (shoe-type) grinding machines;
   - (b) Limited to cylindrical grinding;
   - (c) A maximum workpiece outside diameter or length of 150 mm;
   - (d) Only two axes that can be coordinated simultaneously for "contouring control";
   - (e) No contouring c axis.

2. Sub-item (c) does not control machines designed specifically as jig grinders having both of the following characteristics:
   - (a) Axes limited to x,y, c, and a, where the c axis is used to maintain the grinding wheel normal to the work surface, and the a axis is configured to grind barrel cams; *and*
   - (b) A spindle "run-out" not less (not better) than 0.0006 mm.

3. Sub-item (c) does not control tool or cutter griding machines having all of the following characteristics:
   - (a) Shipped as a complete system with "software" specially designed for the production of tools or cutters;
   - (b) No more than two rotary axes that can be coordinated simultaneously for "contouring control";
   - (c) "Run-out"(out-of-true running) in one revolution of the spindle not less (not better) than 0.0006 mm TIR; *and*
   - (d) The "positioning accuracies" with all compensations available, are not less (not better) than:
     - (i) 0.004 mm along any linear axis for overall positioning;
     - (ii) 0.001° for any rotary

(2) Electrical discharge machines (EDM);

- (i) Of the wire feed type that have five or more axes that can be coordinated simultaneously for "contouring control";
- (ii) Non-wire EDMs that have two or more contouring rotary axes and that can be coordinated simultaneously for "contouring control".

(3) Other machine tools for removing metals, ceramics, or composites:

- (i) By means of:
  - (A) Water or other liquid jets, including those employing abrasive additives;
  - (B) Electron beam; *or*
  - (C) "Laser" beam; *and*
- (ii) Having two or more rotary axes that:
  - (A) Can be coordinated simultaneously for " contouring control"; *and*
  - (B) Have a " positioning accuracy" of less (better) than 0.003".

(d) **"Software"**

- (1) "Software" specially designed or modified for the "development," "production," or "use" of equipment controlled by sub-categories (a), (b), or (c) above;
- (2) Specific "software", as follows:
  - (i) "Software" to provide " adaptive control" and having both of the following characteristics:
    - (A) For "flexible manufacturing units" (FMUs) that consist at least of equipment described in (b)(1) and (b)(2) of the definition of "flexible manufacturing units"; and
    - (B) Capable of generating or modifying, in "real time processing", "part program" data by using the signals obtained simultaneously by means of at least two detection techniques, such as:
      - (1) Machine vision (optical ranging);
      - (2) Infrared imaging;
      - (3) Acoustical imaging (acoustical ranging);
      - (4) Tactile measurements;
      - (5) Inertial positioning;
      - (6) Force measurements;
      - (7) Torque measurement.

Note: This sub-item does not control "software" that only provides rescheduling of functionally identical equipment within "flexible manufacturing units" using prestored "part programs" and a prestored strategy for the distribution of the "part programs".

(ii) "Software" for electronic devices other than those described in sub-items (a) or (b) that provides the "numerical control" capability of the equipment controlled in sub-item 1.2.

(e) **Technology**

(1) "Technology" for the "development" of equipment controlled by sub-items (a), (b) or (c) above, (f) or (g) below, and of the sub-item (d).

(2) "Technology" for the "production" of equipment controlled by sub-items (a), (b) or (c) above, (f) or (g) below;

(3) Other "technology":

(i) For the "development" of interactive graphics as an integrated part in "numerical control" units for preparation or modification of "part programs";

(ii) For the "development" of integration "software" for incorporation of expert systems for advanced decision support of shop floor operations into "numerical control" units.

(f) **Components and parts for machine tools** controlled by sub-item (c) as follows:

(1) Spindle assemblies, consisting of spindles and bearings as a minimal assembly, with radial ("run-out") or axial ("camming") axis motion in one revolution of spindle less (better) than 0.0006 mm TIR;

(2) Linear position feedback units (e.g., inductive-type devices, graduated scales, "laser", or infrared systems) having, with compensation, an overall "accuracy" better than 800 + (600 x L x 10^{-3}) nm, where L equals the effective length in millimeters of the linear measurement; *except* measuring interferometer systems, without closed or open loop feedback, containing a "laser" to measure slide movement errors of machine tools, dimensional inspection machines, or similar equipment;

(3) Rotary position feedback units (e.g. inductive-type devices, graduated scales, "laser", or infrarated systems) having, with compensation, an "accuracy" less (better) than 0.00025″ of arc; *except* measuring interferometer systems,without closed or open loop feedback, containing a "laser" to measure slide movement errors of machine tools, dimensional inspection machines, or similar equipment;

(4) Slide way assemblies consisting of a minimal assembly of ways, bed, and slide having all of the following characteristics:

(i) A yaw, pitch, or roll of less (better) than 2 seconds of arc TIR (Ref. ISO/DIS 230-1 over full travel);

(ii) A horizontal straightness of less (better) than 2 μm per 300 mm length; and

(iii) A vertical straightness of less (better) than 2 μm over full travel per 300 mm length;

(5) Single-point diamond-cutting tool inserts having all of the following characteristics:
  (i) A flawless and chip-free cutting edge when magnified 400 times in any direction;
  (ii) A cutting radius out-of-roundness less (better) than 0.002 mm TIR (also peak-to-peak); and
  (iii) A cutting radius between 0.1 and 5.0 mm, inclusive.

(g) **Specially designed components or sub-assemblies**, as follows, capable of upgrading, according to the manufacturer's specifications, "numerical control" units, motion control boards, machine tools, or feedback devices to or above the levels controlled in sub-items (a), (b), (c), (f)(2), or (f)(3):
  (1) Printed circuit boards with mounted components and "software" therefor;
  (2) "Compound rotary tables."

Technical Note: Definition of Terms:

"accuracy" - Usually measured in terms of inaccuracy, defined as the maximum deviation, positive or negative, of an indicated value from an accepted standard or true value.

"adaptive control" - a control system that adjusts the response from conditions detected during the operation (Ref. ISO 2806-1980).

"camming" (axial displacement) - Axial displacement in one revolution of the main spindle measured in a plane perpendicular to the spindle faceplate at a point next to the circumference of the spindle faceplate (Ref. ISO 230 Part 1-1986, paragraph 5.63).

"compound rotary table" - A table allowing the workpiece to rotate and tilt about two nonparallel axes, which can be coordinated simultaneously for "contouring control".

"contouring control" - Two or more "numerically controlled" motions operating in accordance with instructions that specify the next required position and the required feed rates to that position. These feed rates are varied in relation to each other so that a desired contour is generated (Ref. ISO/DIS 2806-1980)

"digital computer" - Equipment which can, in the form of one or more discrete variables:

a. Accept data;
b. Store data or instructions in fixed or alterable (writable) storage devices;
c. Process data by means of a stored sequence of instructions which is modifiable; and
d. Provide output of data.

N.B. Modifications of a stored sequence of instructions include replacement of fixed storage devices, but not a physical change in wiring or interconnections.

"flexible manufacturing unit (FMU)" [sometimes also referred to as "flexible manufacturing system" (FMS) or "flexible manufacturing cell (FMC)"]

An entry which includes a combination of at least:

a. A "digital computer" including its own "main storage" and its own related equipment; and

b. Two or more of the following:

1. A machine tool described in Section 1.2.;
2. A dimensional inspection machine described in Section 1.3.;
3. A "robot" controlled by Section 1.6.;
4. Digitally controlled equipment controlled by Section 3.4.

"laser" - An assembly of components which produce coherent light that is amplified by stimulated emission of radiation.

"main storage" - The primary storage for data or instructions for rapid access by a central processing unit. It consists of the internal storage of a "digital computer" and any hierarchical extension thereto, such as cache storage or non-sequentially accessed extended storage.

"microprogram" - A sequence of elementary instructions, maintained in a special storage, the execution of which is initiated by the introduction of its reference instruction into an instruction register.

"motion control board" - An electronic assembly specially designed to provide a computer system with the capability to coordinate simultaneously the motion of axes of machine tools for "contouring control".

"numerical control" - The automatic control of a process performed by a device that makes use of numeric data usually introduced as the operation is in progress (Ref. ISO 2382).

"part program" - An ordered set of instructions in a language and in a format required to cause operations to be effected under automatic control, which is either written in the form of a machine program on an input medium or prepared as input data for processing in a computer to obtain a machine program (Ref. ISO 2806-1980).

"positioning accuracy"

Of "numerically controlled" machine tools is to be determined and presented in accordance with paragraph 2.13., in conjunction with the requirements below:

(a) Test conditions (ISO/DIS/230/2, paragraph 3):

(1) For 12 hours before and during measurements, the machine tool and accuracy measuring equipment will be kept at the same ambient temperature. During the premeasurement time, the slides of the machine will be continuously cycled identically to the way they will be cycled during the accuracy measurements;

(2) The machine shall be equipped with any mechanical, electronic, or software compensation to be exported with the machine;

(3) Accuracy of measuring equipment for the measurement shall be at least four times more accurate than the expected machine tool accuracy;

(4) Power supply for slide drives shall be as follows:
  (i) Line voltage variation shall not be greater than ±10 % of normal rated voltage;
  (ii) Frequency variation shall not be greater than ±2 Hz of normal frequency;
  (iii) Lineouts or interrupted service are not permitted.

(b) Test Program (paragraph 4):

(1) Feed rate (velocity of slides) during measurement shall be the rapid traverse rate;

N.B.: In the case of machine tools which generate optical quality surfaces, the feed rate shall be equal to or less than 50 mm per minute;

(2) Measurements shall be made in an incremental manner from one limit of the axis travel to the other without returning to the starting position for each move to the target position;

(3) Axes not being measured shall be retained at mid-travel test of an axis.

(c) Presentation of test results (paragraph 2):
The results of the measurements must include:
(1) "positioning accuracy" (A) and
(2) The main reversal error (B).

"program" - A sequence of instructions to carry out a process in, or convertible into, a form executable by an electronic computer.

"real-time processing" - Processing of data by an electronic computer in response to an external event according to time requirements imposed by external event.

"robot" - A manipulation mechanism, which may be of the continuous path or of the point-to-point variety, may use "sensors" and has all the following characteristics:

a. Is multifunctional:
b. Is capable of positioning or orienting material, parts, tools or special devices through variable movements in three-dimensional space;
c. Incorporates three or more closed or open loop servo-devices which may include stepping motors; and
d. Has "user-accessible programmability" by means of teach/playback method or means of an electronic computer which may be a programmable logic controller, i.e., without mechanical intervention.

N.B. The above definition does not include the following devices:

a. Manipulation mechanisms which are only manually/teleoperator controllable;
b. Fixed sequence manipulation mechanisms which are automated moving devices, operating secondary to

mechanically fixed programmed motions. The program is mechanically limited by fixed stops, such as pins or cams. The sequence of motions and the selection of paths or angles are not variable or changeable by mechanical, electronic or electrical means;

c. Mechanically controlled variable sequence manipulation mechanisms which are automated moving devices, operating according to mechanically fixed programmed motions. The program is mechanically limited by fixed, but adjustable, stops, such as pins or cams. The sequence of motions and the selection of paths or angles are variable within the fixed program pattern. Variations or modifications of the program pattern (e.g., changes of pins or exchanges of cams) in one or more motion axes are accomplished only through mechanical operations;

d. Non servo-controlled variable sequence manipulation mechanisms which are automated moving devices, operating according to mechanically fixed programmed motions. The program is variable, but the sequence proceeds only by the binary signal from mechanically fixed electrical binary devices or adjustable stops;

e. Stacker cranes defined as Cartesian coordinate manipulator systems manufactured as an integral part of a vertical array of storage bins and designed to access the contents of those bins for storage or retrieval.

"run out"(out-of-true running) - Radial displacement in one revolution of the main spindle measured in a plane perpendicular to the spindle axis at a point on the external or internal revolving surface to be tested (Ref. ISO 230 Part 1-1986, paragraph 5.61).

"sensors" - Detectors of a physical phe nomenon, the output of which (after conversion into a signal that can be interpreted by a controller) is able to generate "programs" or modify programmed instructions or numerical program data. This includes "sensors" with machine vision, infrared imaging, acoustical imaging, tactile feel, inertial position measuring, optical or acoustic ranging or force or torque measuring capabilities.

"software" - A collection of one or more "programs" or "microprograms" fixed in any tangible medium of expression.

"tilting spindle" - A tool-holding that, during the machining process, alters the angular position of its center line with respect to any other axis.

"user-accessible programmability"

The facility allowing a user to insert, modify or replace "program" by means of other than:

(a) A physical change in wiring or interconnections: or

(b) The setting of function controls including entry .parameters.

ANNEX No.6

TECHNOLOGIES AND ITEMS SUBJECT TO NON-PROLIFERATION OF CHEMICAL WEAPONS CONTROL

I. CHEMICAL WARFARE AGENTS PRECURSORS :	*CAS.NO*
1. Thiodiglycol	(111-48-8)
2. Phosphorus Oxychloride	(10025-87-3)
3. Dimethyl Methylphosphonate	(756-79-6)
4. Methyl Phosphonyl Difluoride (DF)	(676-99-3)
5. Methyl Phosphonyl Dichloride (DC)	(676-99-1)
6. Dimethyl Phosphite (DMP)	(868-85-9)
7. Phosphorus Trichloride	(7719-12-2)
8. Trimethyl Phosphite (TMP)	(121-45-9)
9. Thionyl Chloride	(7719-09-7)
10. 3-Hydroxy-1-methylpiperidine	(3554-74-3)
11. N,N-Diisopropyl-Aminoethyl Chloride	(96-79-7)
12. N,N-Diisopropyl-Aminoethane Thiol	(5842-07-9)
13. 3-Quinuclidinol	(1619-34-7)
14. Potassium Fluoride	(7789-23-3)
15. 2-Chloroethanol	(107-07-3)
16. Dimethylamine	(124-40-3)
17. Diethyl Ethylphosphonate	(78-38-6)
18. Diethyl N,N-Dimethylphosphoramidate	(2404-03-7)
19. Diethyl Phosphite	(762-04-9)
20. Dimethylamine Hydrochloride	(506-59-2)
21. Ethyl Phosphinyl Dichloride	(1498-40-4)
22. Ethyl Phosphonyl Dichloride	(1066-50-8)
23. Ethyl Phosphonyl Difluoride	(753-98-0)

24. Hydrogen Fluoride	(7664-39-3)
25. Methyl Benzilate	(76-89-1)
26. Methyl Phosphinyl Dichloride	(676-83-5)
27. N,N-Diisopropyl- -Amino Ethanol	(986-80-0)
28. Pinacolyl Alcohol	(464-07-3)
29. O-Ethyl-2-Diisopropylaminoethyl Methylphosphonite (QL)	(57856-11-8)
30. Triethyl Phosphite	(122-52-1)
31. Arsenic Trichloride	(7784-34-1)
32. Benzilic Acid (2,2-Diphenyl-2-Hydroxiacetic Acid) (2,2-Diphenyl-glycolic Acid)	(76-93-7)
33. Diethyl Methylphosphonite	(15715-41-0)
34. Dimethyl Ethylphosphonate	(6163-75-3)
35. Ethyl Phosphinyl Difluoride	(430-78-4)
36. Methyl Phosphinyl Difluoride	(753-59-3)
37. 3-Quinuclidone	(3731-38-2)
38. Phosphorus Pentachloride	(10026-13-8)
39. Pinacolone (3,3-Dimethyl-2 butanone)	(75-97-8)
40. Potassium Cyanide	(151-50-8)
41. Potassium Bifluoride (Potassium Acidic Fluoride)	(7789-29-9)
42. Ammonium Bifluoride (Ammonium Acidic Fluoride)	(1341-49-7)
43. Sodium Bifluoride (Sodium Acidic Fluoride)	(7681-49-4)
44. Sodium Fluoride	(1333-83-1)
45. Sodium Cyanide	(143-33-9)
46. Tri-ethanolamine	(102-71-6)
47. Phosphorus Pentasulphide	(1314-80-3)
48. Diisopropylamine	(108-18-9)
49. Diethylaminoethanol	(100-37-8)
50. Sodium Sulphide	(1313-82-2)

PROPOSED CONTROL LIST OF DUAL-USE CHEMICAL MANUFACTURING FACILITIES AND EQUIPMENT, AND RELATED TECHNOLOGY

I. MANUFACTURING FACILITIES AND EQUIPMENT

1. Reactor Vessels
2. Storage Tanks and Containers
3. Heat Exchangers
4. Distillation Columns*
5. Condensers
6. Degassing Equipment

Reaction vessels, with or without agitators, with total volume greater than 0,1 m^3 (100 l) and less than 15 m^3 (1500 l); storage tanks and containers with a total volume greater than 0,1 m^3 (100 l); heat exchangers; distillation columns of diameter greater than 0,1 m; condensers; degassing equipment; where all surfaces that come in direct contact with the chemical(s) being processed or contained are made from the following materials :

(a) nickel or alloys with more than 40% nickel by weight;
(b) alloys with more than 25% nickel and 20% chromium by weight ;
(c) glass; or
(d) graphite (for heat exchangers only).

7. Filling Equipment

Remotely operated filling equipment in which all surfaces that come in direct contact with the fluid are made from any of the following materials :

(a) nickel or alloys with more than 40% nickel by weight; or
(b) alloys with more than 25% nickel and 20% chromium by weight.

8. Valves and Multi-Walled Piping

Bellows valves, diaphragm valves or double seal valves incorporating a leak detection port, and multi-walled piping incorporating a leak detection port, in which all surfaces that come in direct contact with the fluids are made from the following materials :

(a) nickel or alloys with more than 40% nickel by weight;
(b) alloys with more than 25% nickel and 20% chromium by weight; or
(c) fluoropolymers including PTFE, PVDF, PFA

---

* includes packed columns

9. Pumps

Double-seal, canned drive, magnetic drive, bellows or diaphragm pumps in which all surfaces that come in direct contact with the fluid are made from the following materials :

(a) nickel or alloys with more than 40% nickel by weight;
(b) alloys with more than 25% nickel and 20% chromium by weight;
(c) fluoropolymers including PTFE, PVDF, PFA; or
(d) tantalum.

10. Incinerators

Incinerators designed to destroy CW agents, precursors and munitions, with special handling facilities, with an average combustion chamber temperature greater than 1000°C, in which all surfaces in the waste supply system that come into direct contact with the waste products are made from or lined with the following materials :

(a) nickel or alloys with more than 40% nickel by weight;
(b) alloys with more than 25% nickel and 20% chromium by weight; or
(c) ceramics.

Statement of Understanding
These controls do not apply to equipment which is specially designed for use in civil applications (for example food processing, pulp and paper processing, or water purification, etc) and is, by the nature of its design, inappropriate for use in storing, processing, producing or conducting and controlling the flow of chemical weapon agents or any of the chemicals which are included in the Core List of chemical weapon agent precursors.

II. TOXIC GAS MONITORING SYSTEMS

1. Detectors

Toxic gas monitoring systems :

(a) capable of detecting chemical warfare agents and designated chemical weapons precursors as well as phosphorus, sulphur, fluorine, chlorine and their compounds at a concentration less than 0,3 milligrams per cubic meter of air, and capable of continuous operation; or

(b) capable of detecting compounds having an anticholinesterase function.

III. RELATED TECHNOLOGY

1. Related Technology

The transfer of process technology, including licences, designed for the manufacture of chemical weapons agents or their precursors, and/or for their disposal, or for whole plants designed for their manufacture.

The transfer of technology, including licences, designed for the manufacture of the equipment designed in sections I and II.

ANNEX No.7

TECHNOLOGIES AND ITEMS SUBJECT TO NON PROLIFERATION OF BIOLOGICAL WEAPONS CONTROL

A. Taking into account the prohibition, the non-proliferation, the destroying of biological weapons and toxins, the following activities under international control according to the final Declaration of the third Conference of the Party States regarding to biological weapons and toxins.

1°. Information monitoring, information files.

1.1. Publications monitoring. The scientific military literature referring to biological agents and toxins, must be published into professional periodic publications or other kind of addressability with title and authors. The scientific communications at symposia, national or international meetings, scientific sessions, professional associations. The invention patents, the innovation certificates and patents.

1.2. List of germs which are under the potential international control regarding to handling and transferring of the following microbial, viral agents and toxins.

1.2.1. Viruses

- Chikungunya virus
- Congo-Crimean haemorrhagic fever virus
- Dengue fever virus
- Eastern equine encephalitis virus
- Ebola virus
- Hantaan virus
- Junin virus
- Lassa fever virus
- Lymphocytic choriomeningitis virus
- Machupo virus
- Marburg virus
- Monkey pox virus
- Rift Valley fever virus
- Tick-borne encephalitis virus (Russian Spring-Summer encephalitis virus)
- Variola virus
- Venezuelan equine encephalitis virus
- Western equine encephalitis virus
- White pox
- Yellow fever virus

1.2.2. Rickettsiae
- Coxiella burnetii
- Rickettsia quintana

1.2.3. Bacteria
- Bacillus anthracis
- Brucella abortus
- Brucella melitensis
- Brucella suis
- Chlamydia psittaci
- Clostridium botulinum
- Francisella tularensis
- Pseudomonas mallei
- Pseudomonas pseudomallei
- Salmonella typhi
- Shigella dysenteriae
- Vibrio cholerae
- Yersinia pestis

1.2.4. Genetically Modified Micro-organisms.

Genetically modified micro-organisms that contain DNA sequences associated with pathogenicity arising from aetiological agents, toxins, and source organisms identified in the core list and genetic elements conferring pathogenic qualities other than above mentioned (puch as the producing exo-or endotoxins, the resistance to the antimicrobial substances).

Micro-organisms genetically modified to produce any of the toxins listed below :

1.2.5. Toxins
- Botolinum toxins
- Clostridium perfringens toxins
- Conotoxin
- Ricin
- Saxitoxin
- Shiga toxin
- Staphylococcus aureus toxins
- Tetrodoxin
- Verotoxin

The legislation regarding to the obtaining of the licenses (patents), production and using of the biological agents, equipments know-how, technology, personnel.

1.3. Data on transfers and transfer requests (import and export of biological agents, equipments, know-how, technology, personnel).

1.4. Information regarding outbreaks, identification and confirmation of the etiologic agent by recognized reference institutes.

2°. Data exchange

2.1. These data exchange will be a kind of declarations on microbial agents, viral agents, toxins holding and also the quantities; on protection level and performed activities, specific professional material, equipments puch as fermenter,, testing rooms by aerosolizing, analytical and preparatives centrifuges, freeze-dryings; research programmes, programmes description, target aims, command authority, relations with military bodies, the quantity and the origin of the funds (e.g., programmes of emphasizing) of virulence and toxicity, testing on animals (vaccines, aerosolizing), aerosol dissemination, the methods evaluation for environmental decontamination, micro-encapsulation.

2.2. Notifications

On changes in declarated activities, unusual activities,accidental escapes, unusual outbreaks and military dulls.

3°. Inspections

These are composed of international teams and their aims are :

3.1. Sampling and identification (air, water, soil, biological products, animals, plants).

3.2. Surveillance of some activities, nondisturbing their performance.

3.3. Auditing (copy of records, manuals for training or use, safety regulations according to official manuals, special instructions, financial documents, programmes, questioning of local inhabitants).

4°. The favourable conditions creation for performing of:

4.1. Visits exchange (invitations for scientists, engineers a.a.).

4.2. Inspections

4.2.1. Interviewing (staff, authorities).

4.2.2. Visual inspection (on-going production including capability of safety and security precautions).

4.2.3. Identification of key equipment (systems, devices).

4.2.4. Auditing (copy of records, manuals for training or use, safety regulations, special instructions, financial documents, research programmes, vaccinates).

4.2.5. Sampling of biological products and identification of biological agents.

4.2.6. Medical examinations : questioning, the history of disease, clinical investigations.

5°. Ensuring of continous informations keeping files.

5.1. By instruments (automatic sampling, time-to-time recording, filters testing of air-conditioned devices, fermenters, lines, videotapes).

5.2. By qualified personnel (observers, inspectors).

B. Acquisition or production of biological agents and toxins or weapons, equipment and means of delivery.
All documents referring to acquisition or production of biological agents or weapons must be accessible to international controls.

Core list :

- fermenters (mentioned less capacity) ;
- bioreactors ;
- biological separation equipment ;
- filters, purification equipment ;
- liofilizing equipments, freeze-drying (mentioned less capacity) ;
- sterilization and decontamination systems ;
- microincapsulating equipments ;
- weapons filling equipment ;
- diseminating devices (generally) and aerosolizing (particularly).

For sampling biological products and isolated germs identification, technical conditions and qualified personnel will be assured, as follows:

- microbial culture collection ;
- culture media ;
- biological products for cryo-protection and cryo-drying;

- continous recording and monitoring devices ;
- apparatus for air, water and soil samples ;
- Rx analyses ;
- Vivaria with sensitive animal specie, in standardized life conditions ;
- qualified personnel employing for continous surveillance of pre-established parameters.

The following activities and equipments are subject to international controls :

- culture media obtaining systems and growing of any kind of germs (viruses, rickettsiae, bacteria, fungi, eucariotic organisms) ;
- germs growing in bioreactors ;
- on-going productions including capacities that will be mentioned ;
- mentioning of working parameters ;
- separation and filtration equipment ;
- purifications ;
- safety precautions ;
- products quality control ;
- freeze and spray drying equipment including capacities and their maintenance ;
- packaging capacities ;
- acquiring/requesting of micro-organisms and toxins ;
- acquiring/requesting of biotechnology equipment ;
- filling equipment and capacities ;
- production of ammunition ;
- production of delivery systems ;
- transfer of weapons, equipment, means of dissemination;
- transfer of technology and personnel.

C. Stockpiling or retaining of biological agents and toxins and weapons, equipment and means of dissemination. For there activities and means will not be included disease producing microbial agents considered as eradicated by world Health Organization.

Together with mentioned facilities will be added the following:

- agricultural spraying equipments both those mounted on ground equipment and those mounted on aircrafts including subdimensioned or unmanned aircrafts ;
- cool-rooms, mentioning their capacity ;
- filtering capacity mentioning ;
- air and aquatic warning and detection devices of listed germs;
- meteo-station ;
- facilities for viral and microbial vaccines production;
- bacterial, viral and fungial decontamination equipments.

ANNEX No.8

TECHNOLOGIES AND ITEMS SUBJECT TO NON-PROLIFERATION OF DELIVERY MISSILES FOR MASS-DESTRUCTION WEAPONS CONTROL

GUIDELINES FOR SENSITIVE MISSILE-RELEVANT TRANSFERS

1. The purpose of these Guidelines is to limit the risks of nuclear proliferation by controlling transfers that could make a contribution to nuclear weapons delivery systems other than manned aircraft. The Guidelines are not designed to impede national space programs or international cooperation in such programs as long as such programs could not contribute to nuclear weapons delivery systems. These Guidelines, including the attached Annex, form the basis for controlling transfers to any destination beyond the Government's jurisdiction or control of equipment and technology relevant to missiles whose performance in terms of payload and range exceeds stated parameters. Restraint will be exercised in the consideration of all transfers of items contained within the Annex and all such transfers will be considered on a case-by-case basis. The Government will implement the Guidelines in accordance with national legislation.

2. The Annex consists of two categories of items, which term includes equipment and technology. Category I items, all of which are in Annex Items 1 and 2, are those items of greatest sensitivity. If a Category I item is included in a system, that system will also be considered as Category I, except when the incorporated item cannot be separated, removed or duplicated. Particular restraint will be exercised in the consideration of Category I transfers, and there will be a strong presumption to deny such transfers. Until further notice, the transfer of category I production facilities will not be authorized. The transfer of other Category I items will be authorized only on rare occasions and where the Government: (A) obtains binding government-to-government undertakings embodying the assurances from the recipient government called for in paragraph 5 of, these Guidelines and (B) assumes responsibility for taking all steps necessary to ensure that the item is put only to its stated end-use. It is understood that the decision to transfer remains the sole and sovereign judgement of the Romania's Government.

3. In the evaluation of transfer applications for Annex items, the following factors will be taken into account:
    A. Nuclear proliferation concerns ;
    B. The capabilities and objectives of the missile and space programs of the recipient state ;
    C. The significance of the transfer in terms of the potential development of nuclear weapons delivery systems other than manned aircraft ;
    D. The assessment of the end-use of the transfers, including the relevant assurances of the recipient states referred to in sub-paragraphs 5.A and 5.B below ;
    E. The applicability of relevant multilateral agreements.

4. The transfer of design and productions technology directly associated with any items in the Annex will be subject to as great a degree of scrutiny and control as will the equipment itself, to the extent permitted by national legislation.

5. Where the transfer could contribute to a nuclear weapons delivery system, the Government will authorize transfers of items in the Annex only on receipt of appropriate assurances from the government of the recipient state that :
    A. The items will be used only for the purpose stated and that such use will not be modified nor the items modified or replicated without the prior consent of the Romania's Government;
    B. Neither the items nor replicas nor derivatives thereof will be retransferred without the consent of the Romania's Government.

6. In furtherance of the effective operation of the Guidelines, the Romania's Government will, as necessary and appropriate, exchange relevant information with other governments applying the same Guidelines.

7. The adherence of all States to these Guidelines in the interest of international peace and security would be welcome.

SUMMARY OF THE EQUIPMENT AND TECHNOLOGY ANNEX

Only the full text of the Annex is authoritative, and it should be consulted for precise details.

Category I

... Complete rocket systems (including ballistic missile systems, space launch vehicles, and sounding rockets) and unmanned air vehicle systems (including cruise missile systems, target drones, and reconnaissance drones) capable of delivering at least a 500 kg payload to a range of at least 300 km as well as the specially designed production facilities for these systems.

... Complete subsystems usable in the systems in Item 1, as follows, as well as the specially designed production facilities and production equipment therefor:

- Individual rocket stages ;
- Reentry vehicles ;
- Solid or liquid fuel rocket engines ;
- Guidance sets ;
- Thrust vector controls ;
- Warhead sating, arming, fusing, and firing mechanisms.

Category II

- Propulsion components.
- Propellants and constituents.
- Propellant production technology and equipment.
- Missile structural composites : production technology and equipment.
- Prolytic deposition/densification technology and equipment.
- Structural materials.
- Flight instruments, inertial navigation equipment, software, and production equipment.
- Flight control systems.
- Avionics equipment.
- Launch/ground support equipment and facilities.
- Missile computers.
- Analog-to-digital converters.
- Test facilities and equipment.
- Software and related analog or hybrid computers.
- Reduced observable technology, materials, and devices.
- Nuclear effects protection.

MISSILE TECHNOLOGY CONTROL REGIME (MTCR)

EQUIPMENT AND TECHNOLOGY ANNEX

November 4, 1991

1. Introduction

(a) This Annex consists of two categories of items, which term includes equipment and "technology". Category I items, all of which are in Annex items 1 and 2, are those items of greatest sensitivity. If a Category I item is included in a system, that system will also be considered as Category I, except when the incorporated item cannot be separated, removed or duplicated, Category II items are those items in the Annex not designated Category I.

(b) The transfer of "technology" directly associated with any items in the Annex will be subject of as great a degree of scrutiny and control as will the equipment itself, to the extent permitted by national legislation. The approval of any Annex item for export also authorizes the export to the same end user of the minimum technology required for the installation, operation, maintenance, and repair of the item.

2. Definitions

For the purpose of this Annex, the following definitions apply :

(a) "Development" is related to all phases prior to "production" such as :
  - design
  - design research
  - design analysis
  - design concepts
  - assembly and testing of prototypes
  - pilot production schemes
  - design data
  - process of transforming design data into a product
  - configuration design
  - integration design
  - layouts

(b) A "microcircuit" is defined as a device in Which a number of passive and/or active elements are considered as indivisibly associated on or within a continuous structure to perform the function of a circuit.

(c) "Production" means all production phases such as:
  - production engineering
  - manufacture
  - integration
  - assembly (mounting)
  - inspection
  - testing
  - quality assurance

(d) "Production equipment" means tooling, templates, jigs, mandrels, moulds, dies, fixtures, alignment mechanisms, test equipment, other machinery and components therefor, limited to those specially designed or modified for "development" or for one or more phases of "production".

(e) "Production facilities" means equipment and specially designed software therefor integrated into installations for "development" or for one or more phases of "production".

(f) "Radiation Hardened" means that the component of equipment is designed or rated to withstand radiation levels which meet or exceed a total irradiation dose of 5 x 105 rads (Si).

(g) "Technology" means specific information which is required for the "development", "production" or "use" of a product. The information may take the form of "technical data" or "technical assistance".

1. "Technical assistance" may take forms such as:
   - instruction
   - skills
   - training
   - working knowledge
   - consulting services

2. "Technical data" may take forms such as :
   - blueprints
   - plans
   - diagrams
   - models
   - formulae
   - engineering designs and specifications
   - manuals and instructions written or recorded on other media or devices such as :
     - disk
     - tape
     - read-only memories

Note

This definition of technology does not include technology "in the public domain" nor "basic scientific research".

(i) "In the public domain" as it applies to this Annex means technology which has been made available without restrictions upon its further dissemination. (Copyright restrictions do not remove technology from being "in the public domain").

(ii) "Basic scientific research" means experimental or theoretical work undertaken principally to acquire new knowledge of the fundamental principles of phenomena and observable facts, not primarily directed towards a specific practical aim or objective.

(h) "Use" means :
- operation
- installation (including on-site installation)
- maintenance

- repair
- overhaul
- refurbishing

3. Terminology

Where the following terms appear in the text, they are to be understood according to the explanations below:

(a) "Specially Designed" describes equipment, parts, components or software which, as a result of "development", have unique properties that distinguish them for certain predetermined purposes. For example, a piece of equipment that is "specially designed" for use in a missile will only be considered so if it has no other function or use. Similarly, a piece of manufacturing equipment that is "specially designed" to produce a certain type of component will only be considered such if it is not capable of producing other types of components.

(b) "Designed or Modified" describes equipment, parts, components or software which, as a result of "development", or modification, have specified properties that make them fit for a particular application. "Designed or Modified" equipment, parts, components or software can be used for other applications. For example, a titanium coated pump designed for a missile may be used with corrosive fluids other than propellants.

(c) "Usable In" or "Capable Of" describes equipment, parts, components or software which are suitable for a particular purpose. There is no need for the equipment, parts, components or software to have been configured, modified or specified for the particular purpose. For example, any military specification memory circuit would be "capable of" operation in a guidance system.

ITEM 1 - CATEGORY I

Complete rocket systems (including ballistic missile systems, space launch vehicles, and sounding rockets) and unmanned air vehicle systems (including cruise missile systems, target drones and reconnaissance drones) capable of delivering at least a 500 kg payload to a range of at least 300 km as well as the specially designed "production facilities" for these systems.

ITEM 2 - CATEGORY I

Complete subsystems usable in the systems in Item 1, as follows, as well as the specially designed "production facilities", and "production equipment" therefor :

(a) Individual rocket stages ;

(b) Reentry vehicles, and equipment designed or modified therefor, as follows, except as provided in Note (1) below for those designed for non-weapon payloads :

  (1) Heat shields and components thereof fabricated of ceramic or ablative materials;

  (2) Heat sinks and components thereof fabricated of light-weight, high heat capacity materials;

  (3) Electronic equipment specially designed for reentry vehicles ;

(c) Solid or liquid propellant rocket engines, having a total impulse capacity of 1.1 x 106 N-sec (2.5 x lo lb-sec) or greater ;

(d) "Guidance sets" capable of achieving system accuracy of 3.33 percent or less of the range (e.g., a CEP of lo km or less at a range of 300 km), except as provided in Note (1) below for those designed for missiles with a range under 300 km or manned aircraft;

(e) Thrust vector control sub-systems, except as provided in Note (1) below for those designed for rocket systems that do not exceed the range/payload capability of Item 1 ;

(f) Warhead sating, arming, fusing, and firing mechanisms, except as provided in Note (1) below for those designed for systems other than those in Item 1.

Notes to Item 2:

(1) The exceptions in (b), (d), (e) and (f) above may be treated as Category II if the subsystem is exported subject to end use statements and quantity limits appropriate for the excepted end use stated above.

(2) CEP (circle of equal probability) is a measure of accuracy; and defined as the radius of the circle centred at the target, at a specific range, in which 50 percent of the payloads impact.

(3) A "guidance set" integrates the process of measuring and computing a vehicle's position and velocity (i.e. navigation) with that of computing and sending commands to the vehicle's flight control systems to correct the trajectory.

(4) Examples of methods of achieving thrust vector control which are covered by (e) include :
  a. Flexible nozzle ;
  b. Fluid or secondary gas injection ;
  c. Movable engine or nozzle ;
  d. Deflection of exhaust gas stream (jet vanes or probes) ; or
  e. Use of thrust tabs.

ITEM 3 - CATEGORY II

Propulsion components and equipment usable in the systems in Item I, as follows, as well as the specially designed "production facilities" and "production equipment" therefor :

(a) Lightweight turbojet and turbofan engines (including turbocompound engines) that are small and fuel efficient ;

(b) Ramjet/Scramjet/pulse jet/combined cycle engines, including devices to regulate combustion, and specially designed components therefor;

(c) Rocket motor cases, "interior lining", "insulation" and nozzle, therefor:

(d) Staging mechanisms, separation mechanisms, and interstages therefor;

(e) Liquid and slurry propellant (including oxidizers) control systems, and specially designed components therefor, designed or modified to operate in vibration environments of more than lo g RMS between 20 Hz and 2.000 Hz ;

(f) Hybrid rocket motors and specially designed components therefor.

Notes to Item 3 :

(1) "Production equipment" in the heading to this item includes the following ;

Flow-forming machines, and specially designed components and specially designed software therefor, which :

a. according to the manufacturer's technical specification, can be equipped with numerical control units or a computer control, even when not equipped with such units at delivery, and

b. with more than two axes which can be coordinated simultaneously for contouring control.

Technical Note :

Machines combining the function of spin-forming and flow-forming are for the purpose of this item regarded as flow-forming machines.

(2) Item 3 (a) engines may be exported as part of a

manned aircraft or in quantities appropriate for replacement parts for manned aircraft.

(3) In Item 3(c), "interior lining" suited for the bond interface between the solid propellant and the case or insulating liner is usually a liquid polymer based dispersion of refractory or insulating materials, e.g., carbon filled HTPB or other polymer with added curing agents to be sprayed or screeded over a case interior.

(4) In Item 3(c), "insulation" intended to be applied to the components of a rocket motor, i.e., the case, nozzle inlets, case closures, includes cured or semi-cured compounded rubber sheet stock containing an insulating or refractory material. It may also be incorporated as stress relief boots or flaps.

(5) The only servo valves and pumps covered in (e) above, are the following :
   a. Servo valves designed for flow rates of 24 litres per minute or greater, at an absolute pressure of 7,000 kP2 (1,000 psi) or greater, that have an actuator response time of less than loo msec ;
   b. Pumps, for liquid propellants, with shaft speeds equal to or greater than 8,000 RPM or with discharge pressures equal to or greater than 7,000 kPa (1,000 psi) .

(6) Item 3(e) systems and components may be exported as part of a satellite.

ITEM 4 - CATEGORY II

Propellants and constituent chemicals for propellants as follows :

(a) Propulsive substances :
   (1) Hydrazine with a concentration of more than 70 percent and its derivatives including monomethylhydrazine (MMH) ;
   (2) Unsymmetric dimethylhydrazine (UDMH) ;
   (3) Ammonium perchlorate ;
   (4) Spherical aluminum powder with particles of uniform diameter of less than 500 x lo 6 m (500 micrometer) and an aluminum content of 97 percent or greater ;
   (5) Metal fules in particle sizes less than 500 x lo 6 m (500 microns), whether spherical, atomized, spheroidal, flaked or ground, consisting of 97 percent or more of any of the following: zirconium, beryllium, boron, magnesium, zinc, and alloys of these; Misch metal ;
   (6) Nitre-amines cyclotetramethylene - tetranitramine (HMX) ,

cyclotrimethylenetrinitramine (RDX)) ;

- (7) Perchlorates, chlorates or chromates mixed with powdered metals or other high energy fuel components ;
- (8) Carboranes, decaboranes, pentaboranes and derivatives thereof ;
- (9) Liquid oxidizers, as follows :
  - (i) Dinitrogen trioxide ;
  - (ii) Nitrogen dioxide/dinitrogen tetroxide;
  - (iii) Dinitrogen pentoxide ;
  - (iv) Inhibited Red Fuming Nitric Acid (IRFNA) ;
  - (v) Compounds composed of fluorine and one or more of other halogens, oxygen or nitrogen.

(b) Polymeric substances :

- (1) Carboxy-terminated polybutadiene (CTPB) ;
- (2) Hydroxy-terminated polybutadiene (HTPB) ;
- (3) Glycidyl azide polymer (GAP) ;
- (4) Polybutadiene-acrylic acid (PBAA) ;
- (5) Polybutadiene-acrylic acid-acrylonitrile (PBAN)

(c) Composite propellants including moulded gue propellants and propellants with nitrated bonding.

(d) Other high energy density propellants SUCh as, Boran Slurry, having an energy density of 40 x 106 Joules/kg or greater.

(e) Other propellant additives and agents :

- (1) Bonding agents as follows :
  - (i) tris(1-(2-methyl)aziridinyl)phosphine oxide (MAPO)
  - (ii) trimesoyl-1(2-ethyl)aziridine (HX-868, BITA)
  - (iii) "Tepanol" (HX-878), Reaction product of tetraethlylene-pentamine, acrylonitrile and glycidol
  - (iv) "Tepan" (HX-879), Reaction product of tetlenepentamine and acrylonitrile
  - (v) Polyfunctional aziridene amides with isophthalic, trimesic, isocyanuric, or trimethyladipic backbone also having a 2-methyl or 2-ethyl aziridine group (HX-752, HX-874 and HX-877).
- (2) Curing agents and catalysts as follows :
  - (i) Triphenyl bismuth (TPB)
  - (ii) Isophorone diisocyanate (IPDI)
- (3) Burning rate modifiers as follows :
  - (i) Catocene
  - (ii) N-butyl-ferrocene
  - (iii) Butacene
  - (iv) Other ferrocene derivatives
- (4) Nitrate esters and nitrate plasticizers as follows:
  - (i) Triethylene glycol dinitrate

(TEGDN)
- (ii) Trimethylolethane trinitrate (TMETN)
- (iii) 1,2,4-butanetriol trinitrate (BTTN)
- (iv) Diethylene glycol dinitrate (DEGDN)

(5) Stabilizers as follows :
- (i) 2-nitrodiphenylamine
- (ii) N-methyl-p-nitroaniline

ITEM 5 - CATEGORY II

Production technology, or "production equipment" (including its specially designed components) for :

(a) Production, handling or acceptance testing of liquid propellants or propellant constituents described in Item 4.

(b) Production, handling, mixing, curing, casting, plessing, machining, extruding or acceptance testing of solid propellants or propellant constituents described in Item 4.

Notes to Item 5:

(1) Batch mixers or continuous mixers covered by (b) above, both with provision for mixing under vacuum in the range of zero to 13.326 kPa and with temperature control capability of the mixing chamber, are the following :

Batch mixers having :
- a. A total volumetric capacity of 110 litres (30 gallons) or more; and
- b. At least one mixing/kneading shaft mounted off centre.

Continuous mixers having :
- a. Two or more mixing/kneading shafts; and
- b. Capability to open the mixing chamber.

(2) The following equipment is included in (b) above:
- a. Equipment for the production of atomized or spherical metallic powder in a controlled environment ;
- b. Fluid energy mills for grinding or milling ammonium perchlorate, RDX or HMX.

ITEM 6 - CATEGORY II

Equipment, "technical data" and procedures for the production of structural composites usable in the systems in Item 1 as follows and specially designed components, and accessories and specially designed software therefor:

(a) Filament winding machines of which the motions for positioning, wrapping and winding fibres are coordinated and programmed in three or more axes, designed to fabricate composite structures or laminates from fibrous and filamentary materials, and coordinating and programming controls ;

(b) Tape-laying machines of which the motions for positioning and laying tape and sheets are coordinated and programmed in two or more axes, designed for the manufacture of composite airframes and missile structures ;

(c) Interlacing machines, including adapters and modification kits for weaving, interlacing or braiding fibres designed to fabricate composite structures, except textile machinery which has not been modified for the above end uses ;

(d) Equipment designed or modified for the production of fibrous and filamentary materials as follows:
  (1) Equipment for converting polymeric fibres (such as polyacrilo-nitrile, rayon or polycarbosilane) including special provision to strain the fibre during heating ;
  (2) Equipment for the vapor deposition of elements or compounds on heated filament substrates; and
  (3) Equipment for the wet-spinning of refractory ceramics (such as aluminum oxide);

(e) Equipment designed or modified for special fibre surface treatment or for producing prepregs and preforms.

(f) "Technical data" (including processing conditions) and procedures for the regulation of temperature, pressures or atmosphere in autoclaves or hydroclaves when used for the production of composites or partially processed composites.

Note to Item 6:

(1) Examples of components and accessories for machines covered by this entry are: mould, mandrels, dies, fixtures and tooling for the preform pressing, curing, casting, sintering or bonding of composite structures, laminates and manufactures thereof.
(2) Equipment covered by subitem (e) includes but is not limited to rollers, tension stretchers, coating equipment, cutting equipment and clicker dies.

ITEM 7 - CATEGORY II

Pyrolytic deposition and densification equipment and "technology" as folows:
(a) "Technology" for producing pyrolytically derived materials formed on a mould, mandrel or other substrate from precursor gases which decompose in the 1,300 degrees C to 2,900 degrees C temperature range at pressure of 130 Pa (1 mm Hg) to 20 kPa (150 mm Hg) including technology fot the

composition of precursor gases, flow-rates, and process control schedules and parameters;

(b) Specially designed nozzles for the above processes;

(c) Equipment and process controls, and specially designed software therefor, designed or modified for densification and pyrolysis of structural composite rocket nozzles and reentry vehicle nose tips.

Notes to Item 7:

(1) Equipment included under (c) above are isostatic presses having all of the folowing characteristics:
   a. Maximum working pressure of 69 MPa (10,000 psi) or greater;
   b. Designed to achieve and maintain a controlled thermal environment of 600 degrees C or greater; and
   c. Possessing a chamber cavity with an inside diameter of 254 mm (10 inches) or greater.

(2) Equipment included under (c) above are chemical vapour deposition furnaces designed or modified for the densification of carbon-carbom composites.

ITEM 8 - CATEGORY II

Structural materials usable in the systems in Item 1, as follows :

(a) Composite structures, laminates, and manufactures thereof, including resin impregnated fibre prepregs and metal coated fibre preforms therefor, specially designed for use in the systems in Item 1 and the subsystems in Item 2 made either with organic matrix or metal matrix utilizing fibrous or filamentary reinforcements having a specific tensile strength greater than 7,62 x 104 m (3 x lc6 inches) and a specific modulus greater than 3.18 x lo6m (1.25 x 108 inches);

(b) Resaturated pyrolized (i.e. carbon-carbon) materials designed for rocket systems ;

(c) Fine grain recrystallized bulk graphites (with a bulk density of at least 1,72 g/cc measured at 15 degrees C), pyrolytic, or fibrous reinforced graphites useable for rocket nozzles and reentry vehicle nose tips ;

(d) Ceramic composite materials (dielectric constant less than 6 at frequencies from 100 Hz to 10,000 MHz) for use in missile radomes, and bulk machinable silicon-carbide reinforced unfired ceramic useable for nose tips;

(e) Tungsten. molybdenum and alloys of these metals in the form of uniform spherical or atomized particles of 500 micrometer diameter or less with a purity of 97 percent or higher for fabrication of rocket motor components;

i.e. heat shields, nozzle substrates, nozzle throats, and thrust vector control surfaces;

(f) Maraging steels (steels generally characterized by high Nickel, very low Carbon content and the use of substitutional elements to produce age hardening) having an Ultimate Tensile Strength of 1.5 x 109 Pa or greater, measured at 20 C.

Note to Item 8 :

Maraging steels are only covered by 8(f) above for the purpose of this Annex in the form of sheet, plate or tubing with a wall or plate thickness equal to or less than 5.o mm (o.2 inch).

ITEM 9 - CATEGORY II

Instrumentation, navigation and direction finding equipment and systems, and associated production and test equipment as follows ; and specially designed components and software therefor:

(a) Integrated flight instrument systems, which include gyrostabilizers or automatic pilots and integration software therefor, designed or modified for use in the systems in Item 1;

(b) Gyro-astro compasses and other devices which derive position or orientation by means of automatically tracking celestial bodies or satellites;

(c) Accelerometers with a threshold of 0.05 9 or less, or a linearity error within 0.25 percent of full scale output, or both, which are designed for use in inertial navigation systems or in guidance systems of all types ;

(d) All types of gyros usable in the systems in Item 1, with a rated drift rate stability of less than o.5 degree (1 sigma or rms) per hour in a 1 g environment ;

(e) Continuous output accelerometers or gyros of any type, specified to function at acceleration levels greater than loo g;

(f) Inertial or other equipment using accelerometers described by subitems (c) and (e) above or gyros described by subitems (d) or (e) above, and systems incorporating such equipment, and specially designed integration software therefor;

(g) Specially designed test, calibration, and alignment equipment, and "production equipment" for the above, including the following :

(1) For laser gyro equipment, the following equipment used to characterize mirrors, having the threshold accuracy shown or better:
   (i) Scatterometer (10 ppm) ;
   (ii) Reflectometer (50 ppm) ;
   (iii) Profilometer (5 Angstroms)

(2) For other inertial equipment :
   (i) Inertial Measurement Unit (IMU Module) Tester;
   (ii) IMU Platform Tester ;
   (iii) IMU Stable Element Handling Fixture
   (iv) IMU Platform Balance Fixture;
   (v) Gyro Tuning Test Station ;
   (vi) Gyro Dynamic Balance Station ;
   (vii) Gyro Run-In/Motor Test Station ;
   (viii) Gyro Evacuation and Filling Station;
   (ix) Centrifuge Fixture for Gyro Bearings;
   (x) Accelerometer Axis Align Station ;
   (xi) Accelerometer Test Station.

Notes to Item 9 :

(1) Items (a) through (f) may be exported as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.
(2) In subitem (d) :
   a. Drift rate is defined as the time rate of output deviation from the desired output. It consists of random and systematic components and is expressed as an equivalent angular displacement per unit time with respect to inertial space.
   b. Stability is defined as standard deviation (1 sigma) of the variation of a particular parameter from its calibrated value measured under stable temperature conditions. This can be expressed as a function of time.

ITEM 1o - CATEGORY II

Flight control systems and "technology" as follows ; designed or modified for the systems in Item 1 as well as the specially designed test, calibration, and alignment equipment therefor :
(a) Hydraulic, mechanical, electro-optical, or electro-mechanical flight control systems (including fly-by-wire systems) ;
(b) Attitude control equipment ;
(c) Design technology for integration of air vehicle fuselage, propulsion system and lifting control surfaces to optimize aerodynamic performance throughout the flight regime of an unmanned air vehicle ;

(d) Design technology for integration of the flight control, guidance, and propulsion data into a flight management system for optimization of rocket system trajectory.

Note to Item lo :

Items (a) and (b) may be exported as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.

ITEM 11 - CATEGORY II

Avionics equipment, "technology" and components as follows; designed or modified for use in the systems in Item 1, and specially designed software therefor :

(a) Radar and laser radar systems, including altimeters;

(b) Passive sensors for determining bearings to specific electromagnetic sources (direction finding equipment) or terrain characteristics ;

(c) Global Positioning System (GPS) or similar satellite receivers :

  (1) Capable of providing navigation information under the following operational conditions:

    (i) At speeds in excess of 515 m/sec (1,000 nautical miles/hour) ; and

    (ii) At altitudes in excess of 18 km (60,000 feet) ; or

  (2) Designed or modified for use with unmanned air vehicles covered by Item 1.

(d) Electronic assemblies and components specially designed for military use and operation at temperatures in excess of 125 degrees C.

(e) Design technology for protection of avionics and electrical subsystems against electromagnetic pulse (EMP) and electromagnetic interference (EMI) hazards form external sources, as follows :

  (1) Design technology for shielding systems ;

  (2) Design technology for the configuration of hardened electrical circuits and subsystems;

  (3) Determination of hardening criteria for the above.

Notes to Item 11 :

(1) Item 11 equipment may be exported as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.

(2) Examples of equipment included in this Item :

  a. Terrain contour mapping equipment ;

  b. Scene mapping and correlation (both digital and analog) equipment;

c. Doppler navigation radar equipment ;
d. Passive interferometer equipment ;
e. Imaging sensor equipment (both active and passive);

(3) In subitem (a). laser radar systems embody specialized transmission, scanning, receiving and signal processing techniques for utilization of lasers for echo ranging, direction finding and discrimination of targets by location, radial speed and body reflection characteristics.

ITEM 12 - CATEGORY II

Launch support equipment, facilities and software for the systems in Item 1, as follows :

(a) Apparatus and devices designed or modified for the handling, control, activation and launching of the systems in Item 1 ;

(b) Vehicles designed or modified for the transport, handling, control, activation and launching of the systems in Item 1 ;

(c) Gravity meters (gravimeters), gravity radiometers, and specially designed components therefor, designed or modified for airborne or marine use, and having a static or operational accuracy of 7 x lo m/sec^2 (o.7 milligal) or better, with a time to steady-state registration of two minutes or less ;

(d) Telemetering and telecontrol equipment usable for unmanned air vehicles or rocket systems ;

(e) Precision tracking systems :
   (1) Tracking systems which use a translator installed on the rocket system or unmanned air vehicle in conJunction with either surface or airborne references or navigation satellite systems to provide real-time measurements of in-flight position and velocity ;
   (2) Range instrumentation radars including associated optical/infrared trackers and the specially designed software therefor with all of the following capabilities
      (i) angular resolution better than 3 milli-radians (o.5 mils);
      (ii) range of 30 km or greater with a range resolution better than lo meters RM5 ;
      (iii) velocity resolution better than 3 meters per second.
   (3) Software which processes post-flight, recorded data, enabling determination of vehicle position throughout its flight path.

ITEM 13 - CATEGORY II

Analog computers, digital computers, or digital differential analyzers designed or modified for use in the systems in Item 1, having either of the following characteristics:

(a) Rated for continuous operation at temperatures from below minus 45 degrees C to above plus 55 degrees C ; or
(b) Designed as ruggedized or "radiation hardened".

Note to Item 13 :

Item 13 equipment may be exported as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.

ITEM 14 - CATEGORY II

Analog-to-digital converters, usable in the systems in Item 1, having either of the following characteristics:

(a) Designed to meet military specifications, for ruggedized equipment; or,

(b) Designed or modified for military use; and being one of the following types :
  (1) Analog-to-digital converter "microcircuits", which are "radiation hardened" or have all of the following characteristics :
    (i) Having a resolution of 8 bits or more;
    (ii) Rated for operation in the temperature range from below minus 54 degrees C to above plus 125 degrees C; and
    (iii) Hermetically sealed.

  (2) Electrical input type analog-to-digital converter printed circuit boards or modules, with all of the following characteristics :
    (i) Having a resolution of 8 bits or more;
    (ii) Rated for operation in the temperature range from below minus 45 degrees C to above plus 55 degrees C ; and
    (iii) Incorporating "microcircuits" listed in (1), above.

ITEM 15 - CATEGORY II

Test facilities and test equipment usable for the systems in Item 1 and Item 2 as follows; and specially designed software therefor :

(a) Vibration test equipment using digital control techniques, and feedback or closed loop test equipment therefor, capable of vibrating a system at lo g RMS or more between 20 Hz and 2,000 Hz and imparting forces of 50 kN (11,250 lbs) or greater;

(b) Wind-tunnels for speeds of Mach o.9 or more ;

(c) Test benches/stands which have the capacity to handle solid or liquid propellant rockets or rocket motors of more than 90 KN (20,000 lbs) of thrust, or which are capable of simultaneously measuring the three axial thrust components ;

(d) Environmental chambers and anechoic chambers capable of simulating the following flight conditions :
  (1) Altitude of 15,000 meters or greater; or
  (2) Temperature of at least minus 50 degrees C to plus 125 degrees C; and either
  (3) Vibration environments of lo g RMS or greater between 20 Hz and 2,000 Hz imparting forces of 5 kN or greater, for environmental chambers; or
  (4) Acoustic environments at an overall sound pressure level of 140 dB or greater (referenced to 2 x lo 5 N per square meter) or with a rated power output of 4 kilowatts or greater, for anechoic chambers.

(e) Radiographic equipment capable of delivering electromagnetic radiation produced by "bremsstrahlung" from accelerated electrons of 2 MeV or greater or by using radioactive sources of 1 MeV or greater, except those specially designed for medical purposes.

Note to Item 15 (a) :

The term "digital control" refers to equipment, the functions of which are, partly or entirely, automatically controlled by stored and digitally coded electrical signals.

ITEM 16 - CATEGORY II

Specially designed software, or specially designed software with related specially designed hybrid (combined analog/digital) computers, for modelling, simulation, or design integration of the systems in Item 1 and Item 2.

Note to Item 16 :

The modelling includes in particular the aerodynamic and thermodynamic analysis of the systems.

ITEM 17 - CATEGORY II

Materials, devices, and specially designed software for reduced observable such as radar reflectivity, ultraviolet / infrared signatures and acoustic signatures (i.e. stealth technology), for applications usable for the systems in Item 1 or Item 2, for example:

(a) Structural materials and coatings specially designed for reduced radar reflectivity ;

(b) Coatings, including paints, specially designed for reduced or tailored reflectivity or emissivity in the microwave, infrared or ultraviolet spectra, except when specially used for thermal control of satellites.

(c) Specially designed software or databases for analysis of signature reduction.

(d) Specially designed radar cross section measurement systems.

ITEM 18 - CATEGORY II

Devices for use in protecting rocket systems and unmanned air vehicles against nuclear effects (e.g. Electromagnetic Pulse (EMP), X-rays, combined blast and thermal effects), and usable for the systems in Item 1, as follows:

(a) "Radiation Hardened" "microcircuits" and detectors.

(b) Radomes designed to withstand a combined thermal shock greater than loo cal/sq cm accompanied by a peak over pressure of greater than 50 kPa (7 pounds per square inch).

Note to Item 18 (a) :

A detector is defined as a mechanical, electrical, optical or chemical device that automatically identifies and records, or registers a stimulus such as an environmental change in pressure or temperature, an electrical or electromagnetic signal or radiation from a radioactive material.

THE NATIONAL EXPORT CONTROL AGENCY
(STRUCTURE)

Director General

Director
(COCOM)
- expert
- expert
- expert
- expert
- expert
- expert

Director
(NON-PROLIFERATION)
- expert
- expert
- expert

- economist
- secretary
- typist and shorthand
- archivist